NATURE STUDY

IN

ELEMENTARY SCHOOLS

BY

MRS. L. L. WILSON, Ph.D.

TEACHERS' MANUAL

THE MACMILLAN COMPANY

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A MANUAL FOR TEACHERS

BY

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"Facts are stupid things until brought into connection with some general law."

LOUIS AGASSIZ.

"He is a thoroughly good naturalist who knows his own parish thoroughly."

CHARLES KINGSLEY.

"Both head and heart, —
Both active, both complete, and both in earnest."

ELIZABETH BARRETT BROWNING.

PREFACE

This book is an outgrowth of a rich, varied, and thoughtful experience with child nature and the nature that surrounds the child. Mrs. Wilson recognizes the truth that children have a deep, strong, instinctive love for all things that live and all things that support life. The teacher should develop instinct into habit by making spontaneity the basis of character.

Nature Study to-day is pioneer work. The prevailing methods of teaching nature are the old methods dominated by the delusion of logical sequence, — of isolated fact learning. Mrs. Wilson's plan is to study the child, understand his interests, and adapt conditions to his actual personal needs.

The old method is founded upon a rigid faith in the book and traditional processes; the new upon the divinity of the child and the influence of God's creations upon his growing mind. One method is fixed; the other is everlasting motion over the infinite line of unrealized possibilities. One method demands accurate imitation; the other, original discovery and creation. Under one method the teacher is a pedant; under the other, a student.

The pressing need of the hour is genuine students of education, teachers who bring to every child and every subject a mind full of desire to know, an abiding faith in

boundless possibilities, a freshness of spirit that is in itself the most potent factor in education, a devotion that inspires new contributions to the unlimited science of teaching.

This book is such a contribution, and I am sure it will be a great help to many teachers who are struggling with the problem of Nature Study.

CHICAGO, October 20, 1897. FRANCIS W. PARKER.

SYNOPSIS OF A PRELIMINARY COURSE OF NATURE STUDY FOR CHILDREN IN THE FIRST FOUR YEARS OF SCHOOL LIFE

Arranged according to subject-matter

WEATHER

SEPTEMBER. — Excursions and general observations of the direction and velocity of the wind; appearance and names of the clouds. Daily blackboard record of these facts. Rain. Page 10.

OCTOBER. — Continued study of the appearance and names of the clouds. Individual records made daily of the direction of the wind, its velocity, and the clouds. What the different winds and clouds bring. The sun (first and second years). Page 63.

NOVEMBER. — Examination of October's written record to determine the prevailing wind and cloud forms for that month. Continued observation and individual record of the wind, its direction and velocity, and the clouds. Temperature. The sun (third and fourth years). Moon (first and second years). Page 85.

DECEMBER. — Examination of November's record to determine, as well as possible, the meaning and prevailing character of winds and clouds. The daily record for December should now include the temperature. Snow. Stars (first and second years). Page 108.

JANUARY. — Examination of December's record to determine the meaning and prevailing character of the winds and clouds; the average temperature; the lowest and the highest temperature. January's records should include the rain or snow fall. Lessons on evaporation, boiling, condensation. Page 129.

FEBRUARY. — Examination of the January record; daily record for February; continuation of the lessons on cloud formation, rain, snow, hail, dew, frost, and their effect on plants, animals, stones. Page 153.

MARCH, APRIL, MAY, AND JUNE. — Records and examination of back records continued.

PLANTS

SEPTEMBER. — Autumn flowers; ferns. Page 18.

OCTOBER. — Flowers (*continued*); fruits. Page 71.

NOVEMBER. — Falling leaves; buds; bulbs; fleshy roots. Page 94.

DECEMBER. — Evergreens (spruce, hemlock, pine); either balsam fir, holly, or mistletoe. Page 109.

JANUARY. — Evergreens (*continued*); germination. Page 133.

FEBRUARY. — Germination (*continued*); seed food-supply. Page 158.

MARCH. — Seed food-supply (*continued*); buds. Page 169.

APRIL. — Buds (*continued*); trees; spring flowers. Excursions. Page 199.

MAY AND JUNE. — Flowers; trees; ferns; mosses; lichens; toadstools. Excursions. Page 238.

ANIMALS

SEPTEMBER. — Insects. Page 38.

OCTOBER. — Insects (*continued*); English sparrow. Page 80.

NOVEMBER. — Pigeons; cocoons; preparations of other animals for winter. Page 99.

DECEMBER. — Aquarium animals; fish; tadpoles; snails; mussels. Page 116.

JANUARY. — Common winter resident birds; beaks and feet; bones and feathers. Page 144.

FEBRUARY. — Migrant birds from the north. Page 164.

MARCH. — Earthworms; robin, bluebird, blackbird; bird migrations, — causes and phenomena. Excursions. Page 184.

APRIL. — Moths; butterflies; beetles; bees. Excursions. Page 236.

MAY AND JUNE. — Insects and other animals brought in by children. Excursions. Page 236.

STONES

MARCH. — Soil; mica; sand; clay; quartz; feldspar; pebbles. Excursions. Page 177.

APRIL. — Granite; gneiss; mica schist; soil. Excursions. Page 196.

MAY AND JUNE. — Stones brought in by the children. Excursions. Page 254.

SYNOPSIS OF THE SAME COURSE

ARRANGED ACCORDING TO MONTHS

SEPTEMBER.

NATURE STUDY

INTRODUCTION

THE course of Nature Study outlined in the following pages has already been subjected to the test of practical application in the schoolroom, with excellent results. I believe that it may be pursued with profit to teacher and pupil in any one of the first four years of school life, and in any school however poorly equipped.

It is planned chiefly to meet the needs of the ordinary grade teacher in the public schools of a city. It is designed as an answer to two questions which she will probably ask herself when invited to undertake this work — questions which may present themselves so forcefully as to be received as insuperable objections to the further consideration of the matter:

"Can I teach this subject without scientific training?"

"Where can I gather material on the asphalt pavements and within the brick walls of a city?"

The course here presented does not presuppose special training on the part of the teacher, nor special facilities for the collection of material. It does, however, take for granted a strong desire on her part to do this work, a lively belief in its efficacy, and an earnest effort to become better acquainted with the familiar, yet to most of us unknown face of nature.

It is not my intention to disparage the value to the teacher of special training in science. Nevertheless it may be safely stated that the courses generally pursued in college and university do not necessarily equip the student for practical, every-day work with little children. They need to be supplemented by actual experience.

The plan herein embodied has grown out of scientific training and experience in teaching little children, and I, therefore, present it with some hope that it may be a helpful volume to those teachers who desire to pursue a course in Nature Study.

Recognizing that the search for facts in the ordinary text-books on science is a labor requiring more time than the teacher usually has at her disposal, and, also, perhaps, greater familiarity with technical terms than she might be expected to possess, I have given in the paragraphs marked "Facts" such necessary knowledge on the subjects therein treated as she should have. These facts are accurate and based upon the latest and most eminent authority.

For more extended information on the subjects of the lessons, the following books are suggested:

ANIMALS:

Birdcraft,
Citizen Bird, } Mabel Osgood Wright.

Birds Through an Opera Glass, Merriam.

Winners in Life's Race,
Life and Her Children, } Arabella Buckley.

First Lessons in Zoölogy, Morse.

Needham's Zoölogy.

Frail Children of the Air, Scudder.

Insects, Hyatt and Arms.

Manual for Insects, Comstock.
The Aquarium, Mark Samuels.
Directions for Collecting Insects (free), Smithsonian Institute, Washington, D.C.

PLANTS:

Plants and Their Children, Mrs. Dana.
Bud and Leaf, Flower and Fruit, Botanical Reader, Part I., Botanical Reader, Part II., } Jane Newell.
Story of the Trees, Mrs. Dyer.
Familiar Trees and Their Leaves, Schuyler Matthews.

EARTH SCIENCES:

Earth and Its Story, Heilprin.
Thirty-six Observation Lessons on Common Minerals, Clapp.
First Lesson on Minerals, Mrs. Richards.
Common Rocks and Minerals, Crosby.
Ocean of Air, Father Aldur, Earth and Its Foundation, } Alice Giberne.
Instruction to Voluntary Observers (free), Weather Bureau, Washington, D.C.

MISCELLANEOUS:

Murché's Science Readers.
Nature Study, Jackman.
Fairy Land of Science, Arabella Buckley.
Tommy Anne, Mabel Osgood Wright.

Perhaps nine out of ten teachers, if asked what is the advantage of Nature Study to the child, would say that it consists in the training of the observation through the senses. These are the days when "Sense-Training" is the Shibboleth; and, perhaps, so-called "Nature Study" has contributed more than any other one thing to raise on high this new god; or, it may be, that Nature Study exists in our schools because the new god rules.

That the study of nature rests primarily on observation, and that this rests on accurate sense perception, no one will deny; but that this is the *end* is a supposition fatal to successfully extracting from such a course results more precious to the child, — the cultivation of the judgment and the imagination. Indeed, if a choice must be made, let us cultivate these rather than the senses, for, without imagination, the acutest seeing, hearing, touch, taste, or smell will not help us to an intelligent observation.

Those, therefore, who see only its more limited possibilities will teach the *letter*, — teach it well, perhaps, — but will probably miss altogether the *spirit*. Facts are necessary things. A teacher cannot have too many of them. In truth, the larger her stock of facts, the better will be her perspective; the less imperative her desire to make every one of *her* facts a part of the mental equipment of the child, the greater the chance of escape for the eager mind of the child from being stultified and deadened. Let her therefore gather for herself her facts, and then, guided by her intelligence and her heart, direct her aim toward putting herself and the child in loving touch with whatever of nature there is about them.

In short, then, the teacher of science should

First: Prepare herself thoroughly, arranging her knowledge from the perspective of the child; endeavoring to foresee and to answer the questions which he will probably ask.

In this work she will doubtless find that the class know more than she gave them credit for. This is likely to be particularly true of the boys. Why this is so, I do not know, unless they investigate nature while their sisters are trying to keep their dresses spotless. With the

children's help, therefore, and with her own earnest efforts, she will find herself in possession of a rich store of facts at the end of the year.

In her own study she must take advantage of what others have learned and set down in books. The method of discovery is pedagogically right for the child, but the method of verification is the shortest and safest one for the teacher.

Then when she knows her material, let it ask her questions: "Why am I prickly?" says the Chestnut. "Why do I open in the autumn?" "Why was I closed all summer?" "Why have some of my nuts two flat sides?" "Why have they thick and shiny coats?" "Why are they good to eat?" and many others. Let her think out the answers to them all, and let that question, the solving of which gave her the greatest joy, be the one to which she first leads the children.

Second: Having thus prepared herself, then, with a cool head and a warm heart, let her *leisurely* guide the child's observation, imagination, and reason to the most important truths with reference to the subject of the lesson.

I have said, "Be leisurely." Let her remember that the object is to lead the children to think. Their untrained minds cannot do this in an atmosphere of impatience, emphasis, and hurry. She should not have anxiety to cover a definite ground. Begin, and let the lesson shape itself. If the children are interested and are thinking, the teacher has succeeded, even if she has not taught one fact.

TIME:

This course presupposes at least an hour and a half a week, preferably divided into four periods for third and

fourth year pupils, and the same amount of time divided into periods of *varying* length, according to the kind of work, the time of day, and the temper of the children for first and second year pupils.

This does not include the supplementary reading, drawing, and language, but it does include the very necessary short excursions.

MATERIAL FOR STUDY:

Although the teacher may recognize the value of individual work, she may sometimes find it difficult to procure material in sufficient quantity to give a portion of it to each pupil in the class. In such cases, I have found that the lack is in a measure supplied by distributing to the class hektograph drawings of such animals and plants as could not be gathered in abundance. To help other teachers to do the same, this volume has been illustrated with simple, yet rather detailed drawings which admit of reproduction in this way.

As a proof of the practicability of easily gathering material for the lessons I should like to say that, of the subjects given in the index of this little volume, nearly all the trees, all of the stones and many more, many of the plants, and most of the animals were found within four squares of a well-built-up portion of Philadelphia. There may not be the same variety of material in every city street, but there will be, probably, enough for a year's study, if the will to find it and the desire to use it exist. As for the phenomena of weather — the winds, the clouds, rain, snow, hail, dew, their various causes and effects — a whole world of interest and beauty — what locality is so poor as not to be rich in weather!

In point of fact its *economy* is a strong argument in

favor of a Nature Course in the lower schools. Heaven and earth supply the material independent of School Board appropriations. Those who assert that such a course is possible only with a large laboratory and generous appropriations, speak either with prejudice or without thought.

Excursions:

Last year I made not less than eighty short excursions, each time with classes of about thirty-five. They were children of from seven to fourteen years of age. Without their hats, taking with them note-books, pencils, and knives, they passed with me to the street. The passers-by stopped to gaze at us, some with expressions of amusement, others of astonishment; approval sometimes, quite frequently the reverse. But I never once saw on the part of the children a consciousness of the mild sensation that they were creating. They went for a definite purpose, which was always accomplished.

There was but one exception to this satisfactory experience, and on that occasion a circus parade exercised rival charms, and I withdrew in its favor.

At least one longer excursion into the real country and in the springtime should be taken. For this three things are necessary for the *teacher:*

First: Accurate knowledge of every inch of the ground over which the children are to be taken, and what it will yield to them of interest and information.

Second: Good temper.

Third: A shrill whistle to call the children together when they are scattered over the ground.

For the *children:*

A covered tin-pail in which to carry their treasures.

Butterfly nets and a lunch add to the pleasure of the occasion, but neither is an absolute necessity.

Related Work:

There is no doubt that some of the number work and much of the reading, literature, and language should be based on the science.

The teacher, if left to herself and really interested, would do this unconsciously, but unfortunately the demands of the course of study must be heeded, and the consciousness of this keeps most of us from much experimenting.

This is especially true in the case of arithmetic. I have great faith in Jackman's ideas and suggestions for number, and had I a grade in my entire charge, I should certainly follow in his footsteps. But I cannot speak from experience, and one's own belief does not and ought not to count, except to one's self in these practical days.

With regard to literature, reading, and language, I had unusual opportunities to test all the inviting theories on the subject. I had a typewriter and a mimeograph with which to make such reading lessons as I desired, and such work in language as seemed to me profitable.

My conclusions are these:

First: That either in reading or in language a restatement of the lessons taught is stultifying and uninteresting.

Second: That the study of poems or prose — real literature — on the object studied, or on a related subject, is profitable.

Third: That the giving of additional and interesting information as silent reading is a valuable exercise from every point of view.

Fourth: That the language work should be largely oral, and the attempt made not merely to restate the facts observed and their meaning, but to lead out into further thought on the same subject.

The written language consisted of records in which exactness, brevity, and neatness were insisted upon; original notes; and, whenever a subject was finished, a written résumé, usually illustrated, and always following an oral discussion.

In Color, I am convinced that the initial work, at least, should never be from small objects, but should deal with large masses in obvious perspective. With white chalk and blue paper all the different clouds may be represented; with the ordinary colored crayons, a series of pictures accurately representing the change of seasons as shown, even in cities, by the progressive changes in color, may be made by the children. After this, they may more safely attempt to portray smaller objects, such as the trees, and finally, perhaps, the animals and flowers which they are studying.

With the older children I have found color work with the plants and animals a great waste of time, from the science standpoint, at any rate. They see and learn much more when they attempt to make an accurate drawing. With the little children the reverse is true.

CHAPTER I

SEPTEMBER

Poems:

In September, Lovejoy's Nature in Verse.
September, Helen Hunt Jackson.
September, Wordsworth.
In Time's Swing, Lucy Larcom.

September's nature work must deal with the weather, with the autumn plants, and with insects.

The real subject-matter is the same for all grades; but the amount of information and the method of imparting it must differ materially with the age of the children. Therefore, for the sake of illustration, the work on the weather will be separated into two parts — suggestions for the first and second years, and suggestions for the third and fourth years. It is, however, taken for granted that those interested in the last two years will read over the work outlined for the first two.

WEATHER

WIND AND CLOUDS.

First and Second Years:

The study of weather in the elementary schools has the advantage of having the material supplied without expenditure of school funds; of cultivating the observation and the reason; of laying a good foundation for

geography; and, by means of daily records, of establishing habits of accuracy and neatness.

In beginning the work with children, the approach to this side of nature should be made through the myths, of which a number are clearly a poetizing of natural processes. The stories of Mercury, child of Jupiter and of Maia, in whose footsteps grew beautiful flowers, make a most happy introduction to the study of winds and clouds, and are at the same time an excellent basis for work in literature and language.

Tell them of the wind god, Mercury, who was born at the peep of day, and who grew so rapidly that at noon he sang beautiful songs, accompanying himself on an instrument made out of the shell of a tortoise — music such as we all can hear even in a city when the wind sets the leaves in motion. In the evening of the same day he stole from his half-brother, Apollo, the sun god, his white oxen, which were then grazing on the tops of mountains near by. He covered their hoofs with twigs and drove them backwards into a cave, so that no one might find them. But Apollo, discovering who had taken them, — for who but the wind could drive them away, — insisted that Mercury should go with him to their father Jupiter. Jupiter, having listened to Apollo's complaint, turned to hear the defence of the baby, who, winking, said that Apollo was a bully and a coward to attack a poor little one-day-old infant, who had learned only how to eat and sleep. Jupiter laughed so heartily that, finally, even the angry Apollo joined in his father's mirth at the pranks of the boy, and forgave him. Mercury then presented his brother with his newly made tortoise-shell lyre, in return for which Apollo gave him a beautiful whip, and made him herdsman of his cattle.

Mercury was a great traveller, and, as he loved Apollo's cows, he drove them constantly before him in the great blue meadow which surrounds the whole earth.

This myth should be told to them as a story, not pausing, as I have done in passing, to show its origin in the phenomena of the winds and clouds, but investing it with all the possible charms of literature and art. Guerber's "Myths" and Gayley's "Classic Myths" will be found invaluable for this purpose. Gayley, in particular, in his "Commentaries" in the back of the book gives valuable information concerning pictures and poems. "Nature Myths and Stories," by Flora J. Cooke (15 cents), may be helpful, particularly at first, in enabling the teacher to bridge over the chasm which separates the myth, as told for the adult student in the various text-books on mythology, from the comprehension of the little child.

By means of the hektograph, the outlines, at least, of Giovanni di Bologna's Flying Mercury, the Belvedere Mercury of the Vatican, the Mercury in Repose in Naples, or Praxiteles' Mercury, may be made familiar to the children.

Choose for their first excursion a day when the sky is full of beautiful, billowy, cumulus clouds. Tell them that they are going out to find the blue meadow and Apollo's clouds. Where are the cows going? From what direction does Mercury come? Is he driving them quickly, or moderately, or very slowly? What else is going in the same direction (smoke, leaves, etc.)? If the clouds were not here, how could we tell from what place Mercury was running?

There can be no valid objection to letting the children use the terms "north, south, east, west, northeast, southeast, northwest, southwest," and much unnecessary circumlocution is thus avoided. By all means, use some kind of a compass in teaching direction. A magnetized knitting needle run through a cork and suspended by a silk thread, so that it may move freely, costs practically nothing, and teaches most effectively the north, from which all the other directions may then be taught.

By making excursions at different times of the day, establish these facts:

The wind may often change, both in its direction and velocity during the day. It is usually calm, light, or moderate in the morning, increasing in velocity during the day until it becomes strong or even blows a gale.

The north wind and east wind oftenest bring cold and rain; while the south and west winds usually are warm.

The clouds in the early morning are in layers round the horizon (stratus, or layer clouds), but later, on pleasant days, rise toward the zenith, lose their banded character, and look like great packs of white wool (cumulus, or wool-pack clouds). Sometimes they are very far from us, lighter, more feathery (cirrus, or feather clouds);

sometimes they are gray, low, heavy, and give us rain (nimbus, or rain clouds); and oftenest of all, instead of being simple cumulus, stratus, nimbus, or cirrus, they are puzzling combinations of two kinds. The commonest of these mixed clouds is the strato-cumulus, and the most characteristic, the cirro-cumulus or mackerel sky.

From the Weather Bureau, Washington, D.C., may be had, for the asking, pictures of the various clouds correctly named. While it would be fatal to the main object of nature teaching to teach these forms and names dogmatically to the children, it is certainly essential that the *teacher* should know them, and that she should learn them by daily observation.

RAINDROPS:

The study of the various forms of water, such as rain, snow, hail, etc., has been purposely delayed until January; yet the good teacher will not fail to take advantage of a rainstorm to call attention to shape, varying size, and impression made on the window pane and on the soil by the falling drops.

LITERATURE

Myths:

Tell the story of Æolus, in whose cave Mercury was born; of his children and their work; of Thor and his Hammer; of Aurora's Tears; of Iris; of the Palace of Alcinoüs.

Easy Poems:

What the Winds Bring, Stedman.
Stop, Stop, Pretty Water, Whittier's Child Life.

North Wind,
Wind Song,
Rain Coach,
Rain Song, } Eleanor Smith's Songs for Little Children.

A Million Little Diamonds, St. Nicholas' Songs.

Northerly, Mrs. Dodge's When Life is Young.

How the Winds Blow,
Merry Rain,
Little Raindrops,
Who Likes the Rain, } Lovejoy's Nature in Verse.

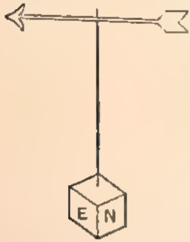
Most excellent language lessons might be given on the people and countries to the north, south, east, and west of us.

Third and Fourth Years:

The first wind lesson in September should be given after lessons in general direction, when it is quite certain that all of the children know which way is north, south, east, west, northeast, southeast, northwest, and southwest. The children should be taken out of doors to notice the direction from which the wind comes, after they have been properly prepared for the work by discussing various ways by which this may be determined, such as holding up the handkerchief, pieces of paper, watching the leaves, clouds, smoke, flags, etc. It must be made perfectly clear that all of these things will be blown in a direction exactly opposed to that from which the wind comes. If, for example, the smoke is going toward the southeast, the wind is from the northwest.

Three excursions to observe the direction of the wind will not be too many. Prepare for these and all other excursions by going over the ground first yourself. Do not fail to make most prominent the point at issue, but, at the same time, do not fail to help them to observe and admire such obvious and wonderful things as the clouds.

Direct their attention to the weather vanes of the neighborhood. Let them discover that the vane always points toward the direction from which the wind comes. It is very simple with a knitting needle, cardboard, and a cubical block to make the model of a weather vane, which the children may, by turns, keep in accordance with facts.



Teach them to estimate the velocity of the wind roughly by applying such words as calm, light, moderate, strong, gale.

Let the children keep a record of the direction and velocity of the wind on the blackboard. It would be well to have the observations made at stated intervals before school, at noon, and, perhaps, just at the close of school, until the fact of variation is established.

The clouds should be observed and described whenever an excursion is taken; but it will be easier for the teacher, at least, if, to teach the names, she chooses days when the clouds are comparatively simple.

The following is suggested as a blackboard record for the wind:

Wind Record for the Month of ....18...

Observations made at ....

Date	Direction	Velocity

Rain:

Take advantage of a rainstorm, either this month or in October, to call attention, not only to the shape, varying size, and impression made on the window pane and on the soil by the falling drops, but also of the effect of the rain on soil in general, as shown by its action in the school yard and street. Let the children observe that, while some of it sinks into the earth, a great deal of it collects together in pools, which, in the descent, tear out small gullies, then join other streams, until, finally, they rush in a torrent down the gutter into the drain. Collect some of this water and allow it to settle. Observe the amount of dirt carried along by this small stream. Observe, too, that the finer sediment falls to the bottom of the glass, while the coarser soil settles above it.

LITERATURE

Miss Rice's "Course in the Study of History and Literature" (20 cents) gives many valuable suggestions for language and literature work, and is, moreover, well graded.

In addition to the myths and poems given for the first two years, I would recommend the following:

Stories and Myths:

Odysseus and the Bag of Winds, } Odyssey.
Phæacian Land,
Æneas and the Winds, Æneid.
The North Wind and the Sun, Æsop.
Four Winds, } Hiawatha.
Story of the Rainbow,
A Drop of Water, Andersen.
Challenge of Thor, Tales of a Wayside Inn.

Poems:

Four Winds, F. D. Sherman (Lovejoy's Nature in Verse).
Night Wind, Eugene Field.
Wind, Robert Louis Stevenson, Child's Garden of Verse.
Extracts from the West Wind, Evening Wind, Winds, Bryant.
Summer Shower, Emily Dickinson.
Rain, Margaret Deland.
The Brook, Tennyson.
To a Cloud, Bryant.
Extracts from Shelley's Clouds.
Rainy Day, Longfellow.

PLANTS AND FLOWERS

In September, should be studied the common wild flowers.

The following tentative division may be useful to some teachers, but in general, use whatever material can be most easily secured.

First Year: Goldenrod, Aster, Wild Carrot, Butter and Eggs.

Second Year: Jamestown Weed, Sunflowers, Black-eyed Susans, Asters.

Third Year: Morning Glories, Pond Lilies, Iron Weed, Thistle.

Fourth Year: Nasturtium (*Tropœolum*), Butter and Eggs, Chicory, Goldenrod, Wild Carrot.

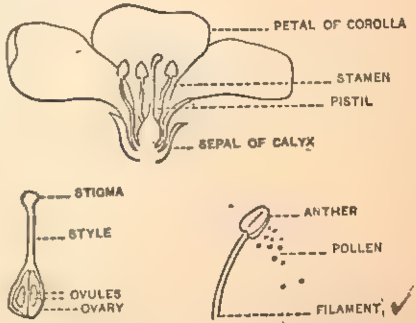
The plants here assigned to the first year are, from the botanist's standpoint, the most difficult of all, but to the lover and teacher of nature they present no more obstacles than the simpler flowers.

Beginning with the second year, teach the names of the floral parts — calyx (sepals), corolla (petals), stamens, pistil — and their uses. Note also the odor, presence of nectar, and its meaning. Lay especial emphasis on the

fact that the flower exists solely for the purpose of forming seed.

Great care must be taken not to let these lessons degenerate into mere object lessons.

As often as possible have the plants growing and cared for in the schoolroom, and follow their life history to the production of fruit and seed, and the germination of the same in the spring.



In all grades study the fern; the curious development of the leaves, if possible, and certainly the formation of its fruit, without the intervention of flowers. Teach the children to watch for plants which do not flower, and for those which do. They will thus learn the necessity for careful, long-continued observation, since they will certainly make many mistakes at first.

Jamestown Weed (Datura Stramonium, D. Tatula).

Thorn apple, Jimson Weed.

Facts:

This half wild plant is found on the borders of cultivated fields and in rubbish heaps. It is not a native of this country, but of Asia and tropical America. Because it was unknown here until the advent of the white people, it received the name of Jamestown, or Jimson Weed. Curiously enough, it has something of the same history

in every country where it is known, following in the steps of civilization, and occupying only waste ground.

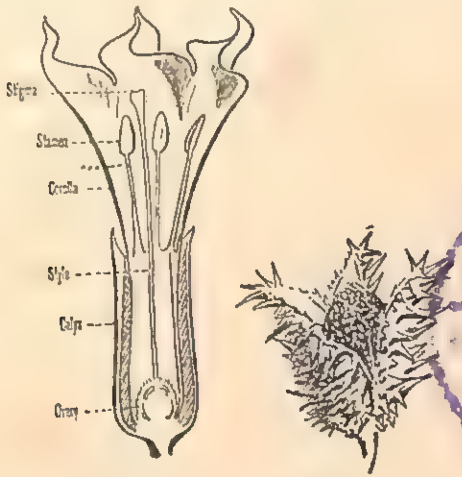
It belongs to the same family as the tobacco and the tomato; but, while these by cultivation have wholly or partly lost their poisonous character, the Jamestown Weed, growing as it will, retains it.

Jamestown Weed. Bud, flower, and fruit, all on the same branch.

It is an annual, of spreading habit and rank odor, which becomes plainly perceptible on crushing the curiously toothed or angled leaves. Children, however, are very apt to like the smell of the flowers, and they always admire their morning glory like beauty. The stems of one variety are purple, and of the other, green. There is the same difference in the coloring of the flowers, although this seems to be also somewhat dependent on the amount of heat and light which they receive. Those which are

somewhat shaded are always paler than those which receive the full warmth of the sun.

The calyx is pale green and fine toothed; the corolla, large, funnel form, and with a five-toothed plaited border; the pistil has a two-lipped stigma; stamens, five. The odor of the flowers attracts numerous insects who, in entering the corolla for the honey, become dusted with



Cross-section of flower of the Jamestown Weed. Ripe pod.

the very abundant pale yellow pollen (flower dust), and then carry this pollen from flower to flower, in going from one to another in search of more food. This is most advantageous for the plant, because, as Darwin has shown, the seeds which result from cross-fertilization, accomplished by the action of the pollen of one flower on the ovules in the seed box at the base of the pistil of another, are usually heavier and more numerous than

those which are formed by the pollen acting on the ovules of the same flower.

The pod, because of an imperfect false partition, appears to be four-celled, except near the top. It is green and prickly until the rather large flat black seeds are ripe. Its color renders it inconspicuous, and the prickles protect it, even should it be discovered. But when the seeds are ripe, the pod becomes yellow and splits open, thus permitting the seeds to escape.

Buds, flowers, unripe and ripe pods are often found on the same plant at one time.

Method:

On a sunny day take the children, if possible, to a waste lot near by. Direct their attention to the bees. Allow each to gather a flower and a bud.

Are there any other visitors to the flower? Why do they go there? Why do you think so? Pull off the white part; touch with the tongue the lower part of it. Put the tongue in the little green cup. What do you taste? What does the bee do with the honey? Do all flowers have honey? How does the bee know that there is honey in this flower? Can the bee see? Can it smell? Does the flower like its visitor? Why?

Even very young children can give intelligent and thoughtful answers to all these questions, except, perhaps, the last two. These it might be better to answer yourself by telling them that the bee is a great help to the flowers, since it carries the dust, which makes the seeds, from one flower to another. Or it might be better to leave these questions unanswered until the children have seen that the great mission of the flower is to produce seed.

After this preliminary out-of-door lesson, plants may be brought into the schoolroom, and the subsequent history there studied.

It is scarcely necessary to indicate the various points to which the observation of the children should be directed. Many teachers err on the side of too much minutiæ, and make these lessons perilously near the old-time object lesson.

Function should precede form. It is important for the children to realize that the roots anchor and feed the plant; that the stem is strong enough to hold the leaves and flowers, and is turgid with food; that the leaves are arranged so that the greatest surface is exposed, and that no one leaf laps over the other; that the flower by its odor, size, and color attracts insects which carry the pollen to other flowers, thus fertilizing the ovules; that when this is done the flowers fade, so that the whole energy of the plant may be turned into the manufacture of seeds, which, while unripe, are protected by an inconspicuous green and prickly pod which opens later, however, to distribute them. It is not important at all to know that the root is fibrous, nor even that the ovate leaves are palmately veined, with a sinuate tooth margin, and are alternately arranged on the stem.

As a general rule, systematic observation defeats its object and stultifies the perceptions of the children. Therefore the main point should be to keep the *life* side before them; to make them know by loving, and love because they are thinking.

For this object the following additional questions may be useful: What is inside the pod? Are seeds good to eat? Would any hungry animals be likely to see these pods? Why not? If they did, would they enjoy eating

them? Why not? Why else is the pod closed? Why does it open later?

Now would be an excellent time to tell of its history and the meaning of its name.

Obviously, even the superficial study of this plant would require one excursion, and not less than four additional lessons.

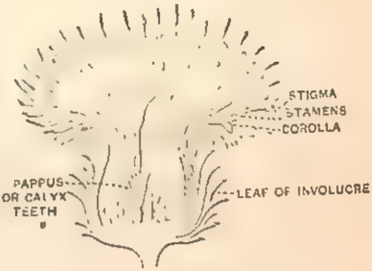
The plant, flowers, leaves, and pods should furnish the material for the drawing lessons immediately succeeding. For reading lessons with second year children, valuable suggestions will be found in Florence Bass' "Nature Stories for Young Readers." For third and fourth year children, the history of the settlement of Jamestown, some account of the introduction of other plants by immigration, or the story of Cats and Clover, as related by Darwin (Swinton's Nature Reader), would be more profitable than a résumé of their observation on the plant. Aside from the reproduction of these lessons by drawing, my own experience teaches me to place little value on written work. It is much more important that opportunity should be given to all to talk at length and connectedly. More time must be given to oral expression, if the children are ever to write naturally and well.

THISTLE (Cnicus lanceolatus).

Facts:

This plant, too, is not native, but has been introduced from Europe. It is fond of rich soil, although it flourishes in dry fields, because of its thick leaves. It has a round, brown, tough taproot, with a stiff upright hollow grooved stem, which bears the prickly winged leaves, woolly underneath, and the large terminal heads of pur-

ple flowers. These heads are surrounded with an involucre, every scale of which is tipped with a prickle. The flowers themselves are tubular with both stamens and a pistil, and inserted on a receptacle which is thickly clothed with soft hairs. They are fragrant and contain nectar. The fruits have abundant pappus, "thistle down," by reason of which the thistle is widely distributed. Indeed, the only way to get rid of it is to cut it down before it flowers, and even this will be of small use unless every one in the neighborhood does the same thing. The thistle belongs to the order of Composites, so called, because the flower heads are composed of many flowers. To this same order belong most of the common fall flowers, such as the goldenrod, aster, iron weed, boneset, snake root, thoroughwort, cone flower, sunflower, yarrow, tansy, burdock, chicory, as well as the everlasting, the daisy and the dandelion, which bloom in the spring. As the flowers of this family are seldom self-fertilized, the advantage of the closely crowded conspicuous head is evident. Doubtless to protect the nectar from being diluted by the dew and rain, they open only in bright light.



Head of thistle with bud and flower.

Method:

Take the children out on a sunny day to observe the bees and to collect material, if this be possible. Thistles are not, however, found abundantly within city limits, and it may be necessary for you to collect the material

yourself. One plant is essential, with enough flower heads so that each child may have a portion.

Do the bees visit this flower? Why do you think so? What is the little purple thing with a long white tube which you hold in your hand? Why do you think that it is a flower? What other plants do you know in which many flowers are crowded together in one head? Is it better for the flowers to live in this way, rather than singly? Why? Why is it better for the flowers to be more easily seen? Why is it good for the bees to visit it? How else can the bees tell that the thistle has honey for it and wants it to come? What good are the prickly scales round the flowers? What good are the prickles on the leaves? When does the flower go to sleep? How? Why? Why is it closed on rainy days? What is the good of the thistle down to the young fruits? Why is it better for the young seeds to sprout far away from the mother plant?

These lessons on the thistle should be followed up with drawings, a great deal of oral, and a limited amount of written expression.

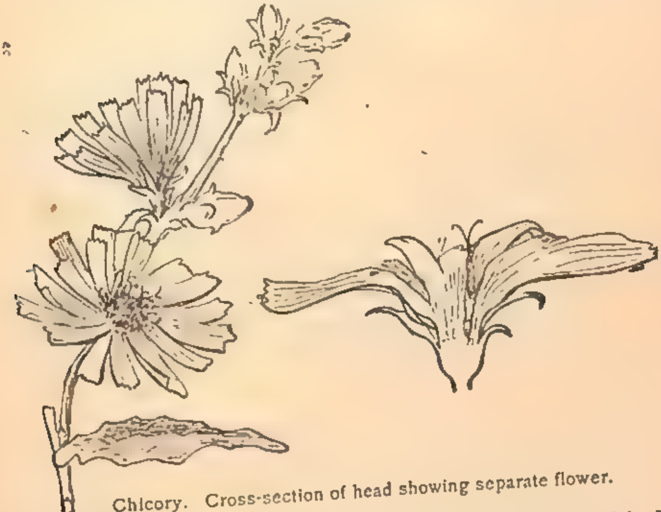
There are several stories of the thistle which would make excellent language or reading lessons, such as Andersen's charming tale of "The Thistle," and the "Cousin of the Rose" in Stories from Fairy Land. Mrs. Dodge's "Thistle" is excellent. "How West Wind Helped Dandelion," in Emilie Poulsson's In the Child's World would help to drive home the fact of the distribution of seeds.

The following salient points with reference to the other flowers mentioned may be of use. I have purposely omitted much that any one might see, and have selected the more interesting points, and sought to give information not readily obtained by the amateur. It is taken

for granted that no one will attempt to teach all the details of any plant.

THE COMPOSITES:

As before stated, the goldenrod, aster, sunflower, black-eyed Susan (cone flower), ironweed, and chicory belong to the Composites, and have the same general char-



Chicory. Cross-section of head showing separate flower.

acteristics as the thistle. The ironweed, like the thistle, has tubular flowers only. Chicory, like the dandelion, has only strap-shaped flowers. All of the others have strap-shaped (ligulate) flowers round the margin and tubular ones in the centre. To the former is given, therefore, the name ray flowers, while the latter are called disk flowers — names doubtless derived from the respective resemblance of each to the rays and disk of the sun.

CHICORY was introduced from Europe and is found by

dusty roadsides. It is an excellent flower to study with children who have already mastered the floral parts, because no other common composite, except the sunflower, shows so clearly the structure. The ovary is large; above it are the small chaffy scales which make up the calyx; the corolla is, of course, easily seen; the stamens with the heads or anthers united are exceptionally plain, and above them rises the pistil with its stigma, two-cleft when ripe.

Goldenrods, showing some of their different habits of growth. 1. Early Goldenrod. 2. S. rugosa. 3. Elm-leaved Goldenrod (S. ulmiflora). 4. S. lanceolata 5. S. canadensis. 6. Blue-stemmed Goldenrod (S. caesia).

Goldenrod: The flowers of the goldenrod are much too small to be studied botanically; but the plant itself may be made interesting by comparing the common species, noting particularly their differences, which are obvious, though the ordinary observer will, with difficulty, believe that there are some forty-two native eastern species, of which at least a dozen are common. It would be a profitable lesson to collect sufficient of two or three different kinds for the children to compare them, giving the differences.

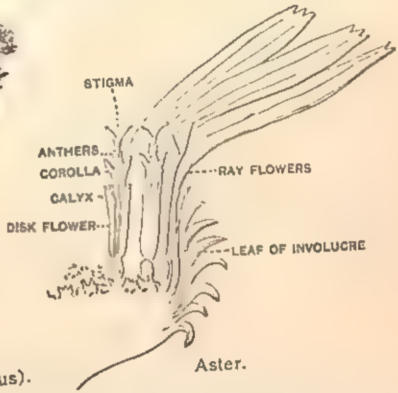
Notice particularly the stem, which may be rough, hairy, or smooth, — gray, blue, or green, — unbranched;

with several long main branches, or with short branches. The leaves are various, and, in one species, quite fragrant, shiny, and well formed.

Asters, or star flowers, are almost as various as the goldenrod and, although their structure is much more obvious still their chief value in this grade is æsthetic and literary.

Sunflower: A characteristic held in common by all of the other composites, and likewise by many other

Blue Aster (A. cordifolius).



Aster.

flowers not of this order, is that of "sleeping," or the change in position of the parts of the plants with reference to the light. This peculiarity is conspicuous in the sunflower probably because of its large size, and has caused this flower to be held in reverence by people of past ages. The Peruvians, who, at the time of the Spanish Conquest were sun worshippers, decorated the maidens of the temple with crowns of golden sunflowers, branches of which were carried in their hands. Sunflowers were and are still used in the decoration of Christian churches. In the Cathedral at Rheims, they

form the aureoles of both the Virgin and St. John, the flowers turning toward the figure of Christ on the Cross as toward their true sun. "The sunflowers not only rejoice at the sight of the sun, but follow with loving fidelity the attraction of its rays, gazing at it and turning toward it from its rising to its setting," wrote St. Francis

Sweet Clover. Day position, 9 A.M.

Sweet Clover. Sleep position, 12.30 A.M.

de Sales, an observation and sentiment repeated by Moore when he sang,

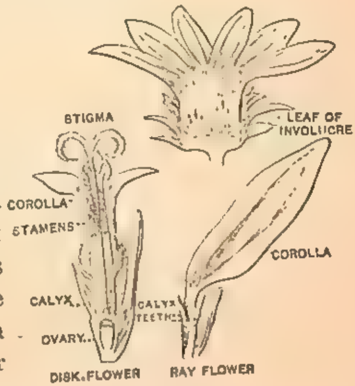
> "The sunflower turns on her god when he sets
> The same look which she turned when he rose."

As a matter of fact, this following of the sun is much less exact than the poets would have us believe, and is undoubtedly, as in other flowers, due to the necessity of protecting the nectar, as well as the organs of reproduction from the dangers of the night, chief of which are cold and dew. The leaves of the sunflower, too, like those of peas, wistaria, jewel weed, cabbage, and many others, have sleep movements.

These movements may be observed to a limited extent

by making use of rainy days, particularly if the plants are growing in the school yard.

The florets of the sunflower are large and, therefore, excellent for strictly botanical study. Two sunflowers will be enough for a whole class, one to be kept entire to show the relationship of the parts. From the other, both ray and disk flowers should be removed, giving one of each kind to each child, and saving the now chaffy receptacle surrounded by the green, leaf-like involucre for the class as a whole.



Sunflower.

The ray flowers have neither stamens nor pistils. Their only reason for existence is to make the head more conspicuous. The disk flowers, whose duty it is to set seed, have corolla, five stamens, and a pistil, with a two-cleft stigma, like other tubular flowers of this order. The calyx consists of two or more thin deciduous scales, and, as in all of the Composites, of the enveloping coat of the ovary, or seed box. In the younger flowers, in which the pollen is ripe, the stigma has not yet opened. When it does appear above the encircling stamen heads (anthers), and opens out its inner stigmatic surface, which the pollen must touch in order to insure fertilization, the pollen has disappeared. But bees and flies, visiting it for the sake of its honey, then bring to it pollen from other flowrets.

Black-eyed Susan, purple cone flower or yellow daisy, as it is variously called, is a western flower which came to

us with clover seed and has spread into our fields. The structure of its flower is very similar to that of the sunflower. Like many other plants, its root leaves are different from the stem leaves.

Black-eyed Susan, or Purple Cone Flower.

The WILD CARROT, very commonly found even within city limits in waste lots, is sometimes called Bird's Nest, because the flower clusters are hollowed out in the centre, although, when quite in bloom, the top is flat or convex, instead of concave. This plant belongs to the same family as parsley, caraway, and carrot. One of the distinguishing traits of the family is the flower clusters, which look much like inverted umbrellas.

Not less common is BUTTER AND EGGS, or Toadflax. This flower will be an easy riddle for children who know the floral parts perfectly. The five-parted calyx is obvious enough, but the two-lipped, irregular corolla is a little puzzling. The honey is secreted at the base of the ovary, but is kept in the spur. No animals can get at it, but those with long tongues, such as the bumble bee. Guided by the bright orange of the lower lip, the bee presses it down and helps himself to the nectar within.

Wild Carrot.

The structure of the flower of the MORNING GLORY is very evident. Note also the star, and the fact, rather

unusual among flowers, that there are red, white, and blue kinds, all of which has made it a popular candidate for the national flower. The twining of the stem is also worthy of note. Like most climbing plants, it twines against the sun; that is, from the left to the right hand of the observer. The hop and some honeysuckles reverse this movement. The motion is quite rapid, and, on a hot day, only about two hours are required for the growing tip to travel round a circle. When the free end is a foot or two in length, this motion can actually be seen.

The WATER LILY, like most of the other flowers already mentioned, sleeps at night. Perhaps the most interesting thing about it, is the fact that there is no absolute difference between sepals and petals, or between petals and stamens. The outer leaves, it is true, are green and shining outside, but they are white within, and the succeeding leaves are tinged with green. As we travel still farther within, they become tipped with yellow, finally bearing anthers (stamen heads), until at last we reach perfect stamens.

Common Toadflax (Butter and Eggs), fruit and flower.

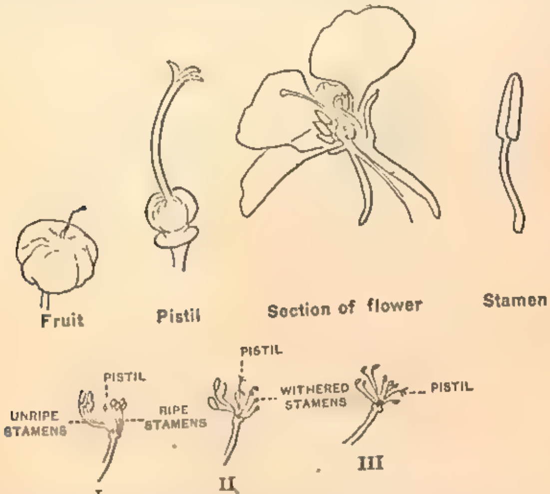
This illustrates most beautifully the probably common origin of the floral parts, and suggests the following questions: Why are the calyx leaves usually green? Why are the petals oftenest brilliant in color? How was the bag or anther of the stamen originally formed? Why does the pistil leaf of most flowers swell at the base? Obviously, the advantage of the first is its inconspicuousness which makes it a better cover or protection, whereas the second, for a contrary reason, is conspicuous, helping to attract to the flower animals which will transfer the contents of the stamen box (pollen) to the contents of the seed box (ovary) of another flower.

Garden Nasturtium.

The Garden Nasturtium (*Tropæolum*) flowers abundantly. It is better for the plants, moreover, to remove the flowers, since by so doing the formation of seed is prevented and, in consequence, new flowers are put forth.

The calyx is made up of five parts, united into one, while the five petals are separate. There are eight stamens, which in the bud are bent down. Each one as it ripens rises separately, until it stands directly in the passageway to the spur. This will be found, on biting it off, to be full of honey. It takes about three days for all of

the stamens to rise, ripen, and discharge the pollen. After this is accomplished, the pistil elongates, and, spreading out its three branches, stands just where the stamens stood, so that an insect coming for the abundant nectar of the spur could not fail to deposit on it any pollen with which he may have been decorated in visits



Garden Nasturtium. Different positions assumed by stamens and pistils in ripening.

to younger flowers. Their brilliant color and strong odor draw many insects to them, and the honey guides, or dark lines of the corolla which lead to the spur, perhaps show them the way to the treasure within. Notice that the position of the flower protects it from rain and also makes of the lower lip a convenient landing place for the insect.

The flowers and leaves are sometimes used for salad, tasting not unlike water-cress. The fruit makes an excellent pickle.

FERNS:

In early September, it is sometimes possible to gather fern plants with a few leaves still in the bud. These leaves, or fronds as they are usually called, are rolled.

Fern, showing developing leaves.

They may be unrolled for a short distance, but the inner portions are as yet undeveloped, and hence well protected. Many kinds are also covered with a brown wool, which makes an additional protection against rain and changes of temperature. Both these points are better observed, however, in the spring.

The fern has no flowers, and hence no seed. How then is it reproduced? By means of spores, which are borne usually on the under side of the leaflets, but sometimes make up the whole stalk. Often, too, they make up the larger part of the upper leaflets, while those below are quite barren.

Rock, Wood, and Meadow Fern.

In the vicinity of Philadelphia, the small rock fern, the common wood fern (Christmas fern, as it is often called for obvious reasons), and the large bracken fern have thick leaves which do not quickly fade. Not less

common are the finer-leaved meadow fern, the sensitive fern, and the cinnamon fern.

SOME LITERATURE WITH REFERENCE TO SEPTEMBER PLANTS

Myths, Legends, and Stories:

Clytie (The Sunflower).

Sunflower and Rush-light, Mrs. Ewing.

Lotus Eaters, The Odyssey (A Water Lily).

Golden Rod and Aster, Marah Pratt's Fairy Land of Flowers.

The Closed Gentian, Marah Pratt's Fairy Land of Flowers.

Bracken Fern, or Brake. *a*. Fruit of the Brake. *b*. Fruit of the Rock Fern. *c*. Fruit of Wood and Sensitive Ferns.

Sensitive Fern. I. Vegetative leaf. II. Spore-bearing leaf. III. Magnified fruit.

The Thistle, Andersen.

The Cousin of the Rose, Stories from Fairy Land.

Training and Restraining, Mrs. Gatty's Parables from Nature.

Easy Poems:

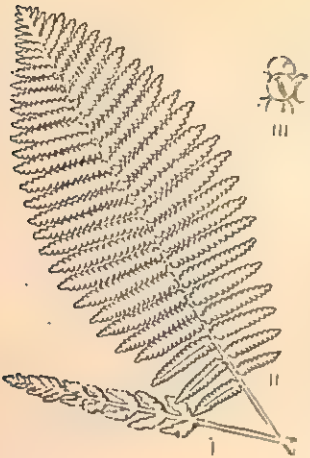
Little Purple Aster, Fairy Land of Flowers.

Thistles, Mrs. Dodge's When Life is Young.

More Difficult Poems:

Golden Rod, Lucy Larcom.

Golden Rod, Elaine Goodale.



Cinnamon Fern. I. Spore-bearing leaf. II Vegetative leaf. III. Magnified Fruit.

Asters and Golden Rod, Helen Hunt Jackson.

September, Helen Hunt Jackson.

Water Lily, Reynolds, Fairy Land of Flowers.

Petrified Fern, M. L. B. Branch, Fairy Land of Flowers.

Fringed Gentian, Bryant.

Extracts from the Corn Song, Whittier.

Legend of Mondamin (Corn), Hiawatha.

Blessing of the Cornfields, Hiawatha.

Chicory, Margaret Deland.

Ferns, Tabb.

Ferns, Song Echoes.

Thistle, Alice Cary.

ANIMALS

In September there is abundance of insect life of all kinds and in all stages. For their study in the schoolroom, a home for larvæ, and, if possible, another for the adult forms, are needed.

Glass aquaria, the tops covered with netting, will answer the purpose. For caterpillars, there should be a layer of earth, at least two inches deep, kept fairly moist, and plenty of fresh leaves each day. It is a good plan to keep these leaves in a narrow-necked bottle of water. Unless the opening is well filled with the stems, put them through a piece of cardboard or paper, thus preventing the possibility of death to the larvæ from drowning.

The adults, if butterflies or sphinx moths, need food in

the shape of a diluted syrup of sugar and water. This most of them will take from the finger. If they are not disposed to eat, uncoil the tongue gently with a pin, holding the insect firmly but carefully by the vertically appressed wings, and letting the tip of the tongue come in contact with the syrup. If still he will not eat, fresh fragrant flowers will, perhaps, tempt him. At any rate, if he does not partake of their bounty, he cannot be very hungry.

In the home for the butterflies should be placed also twigs and branches. Instead of glass aquaria, a soap box, in each corner of which are fastened uprights of wood, round and above which is nailed either wire or cotton netting, may be used.

Grasshoppers, locusts, crickets, ground beetles, will flourish in caterpillar cages. They need abundance of fresh grass. The locusts will certainly deposit their eggs in the soil. The ground beetles should be placed under a stone. In every case, the secret of success is to imitate nature.

The habits of these animals, what and how they eat, breathe, and move, are the most important points for study. In my own experience, I found that giving the children a simple definite question to be answered the next day made them observe intelligently at recess, after school, and in the mornings. The teacher must remember this object, and with a word and real interest on her own part stimulate them. The following questions illustrate the point: What does the locust eat? How does he jump? Does he walk? Can he close his eyes?

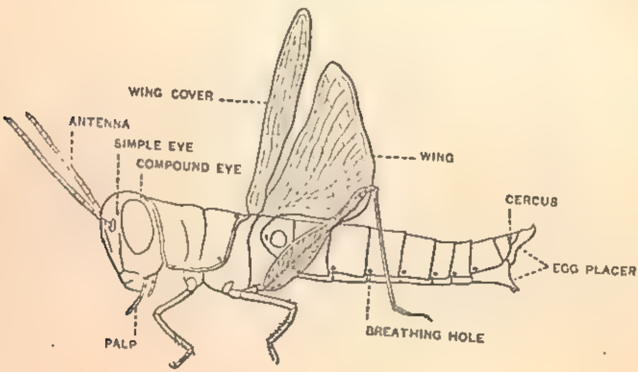
After this preliminary work, it is desirable, by means of the hektograph, to make drawings for each child, illustrating the animal studied.

THE LOCUST (commonly called Grasshopper).

Facts:

The following may be observed by the children, and must be seen by the teacher, if she is to do intelligent work.

In color, the locust imitates its surroundings, and this imitation, by making it difficult to discover it, protects it from its enemies, as does also its power of rapid move-



Female Locust.

ment and its thick outside covering. Its head has a wide range of movement, which gives to the insect a wide range of vision, in spite of its motionless eyes. Besides the large compound eye on each side of the head, there are three small eyes in the middle of its forehead. The antennæ, or feelers, are sense organs. They move freely in any direction, and convey to the brain of the animal prevemation of the outside world, perhaps, by touch or by drowning. The mouth parts move from side to side, while The adults, 's sometimes held its food.

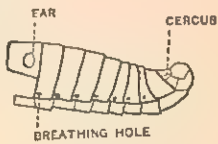
The "tobacco" is partly digested food and seems to be used for defensive purposes.

Back of the head is the chest, to each of whose three parts is attached a pair of legs. The first pair points forward, the second outward and backward, and the third, which is more than double the length of either of the others, points upward and backward. In leaping, the insect uses its first pair of legs as points of resistance, pushing with the third pair, which then straighten out as he jumps long distances into the air. In walking, the legs seem to be used somewhat alternately.

The first pair of wings, wing covers, serve to protect the delicate gauzy wings folded like a fan beneath. Both are strengthened by veins.

The male locust sings by rubbing his legs against the wing covers.

The abdomen is made up of ten segments, which gives much freedom of motion. The numerous breathing holes are along each side, so that a locust would have to be held, not with the head, but with the body in the water in order to drown it.

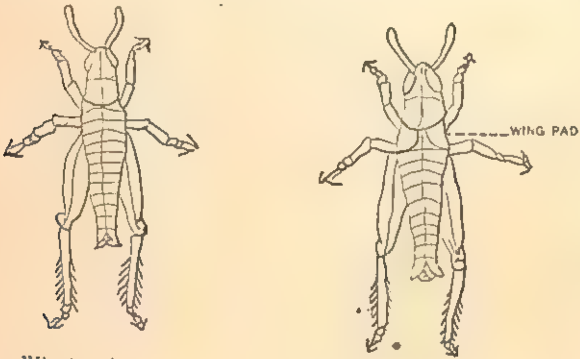


Abdomen, Male Locust.

At the end of the abdomen of the female are hard brown pincer-like organs, which make the hole in the ground in which the eggs are laid. These eggs, usually about twenty-eight in number, are long, yellow in color, and very commonly found. The young locusts hatch out in the early summer, looking very like the mother, except that they have no wings. About July they shed the outer covering and come out larger and with wing pads developed. In succeeding moults, these increase in size, until, at last, in the fourth moult, the wings develop.

In the neighborhood of Philadelphia, the wingless and wing-pad forms are abundant in June and the early part of July.

There are several parasites, internal (worms) and external (a red mite), which infest the locust, but their most powerful enemies are the birds, and a digger wasp which stings them and leaves them helpless, but alive, as food for its young.



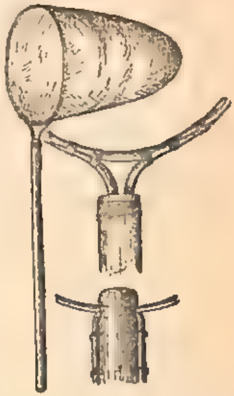
Wingless larva. Nymph.

Locusts.

Method :

These animals may be collected in large quantities by sweeping the grass on a sunny day with a butterfly net. This net may be bought for twenty-five cents, or less, or may be made. A piece of dowelling, one-half inch in diameter and three feet long, will serve for a handle, although a bamboo handle of greater diameter would be better. An excellent rim may be made from rattan, about the thickness of a lead pencil, or from wire. The rattan should be bent into a circle, about a foot in diameter, the two free ends placed outside of the handle and bound to it

with staples or by winding round with wire. By means of carpet thread, a net of mosquito netting, preferably green or brown, a foot and a half long, may be sewn to the rim.



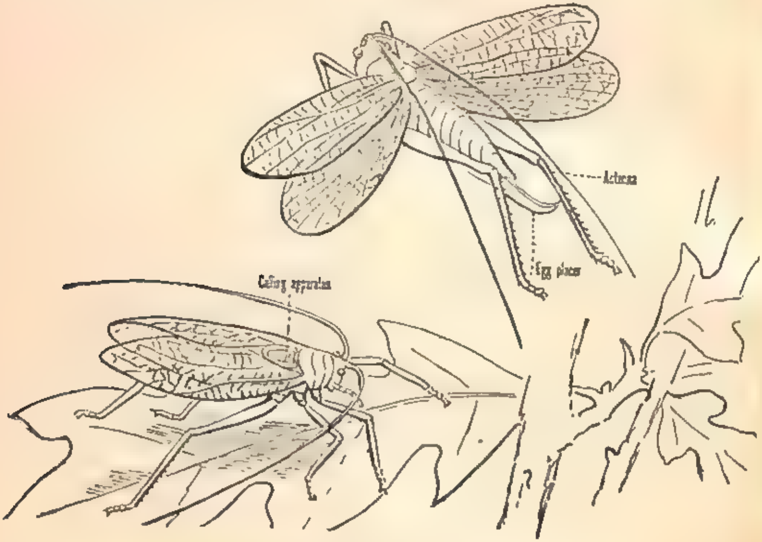
When caught, the locusts should be placed in a glass or soap-box vivarium, in the bottom of which there is good moist earth. They are enormous eaters, and should have a plentiful supply of fresh grass every day. Remove those that die, and mount one of them with the wings spread. For this purpose a "setting board" will be useful. This may be made by nailing or glueing two pieces of bevelled-edged board or cork on a level piece of board, so that there is a half-inch groove between. In this groove the body rests while the wings are stretched and kept in place for a few days with narrow strips of paper. If the insect has just died, there will be no trouble in doing this, but if he has been dead a day or so, it is safer to soften the wing joints by putting the locust in a piece of paper on moist sand for twenty-four or forty-eight hours.

Setting board. Swallow-tail Butterfly.

Let those children who will bring a tumbler or, better, a preserving jar with earth in the bottom and netting across the top, have a few locusts for themselves.

Let the children answer such questions as these: What

is the name of these insects? Why are they so called? What color? What other colors do they sometimes have? Why? Who are their enemies? How can they make themselves disagreeable to these enemies? How can they escape them?



Mr. and Mrs. Katydid.

Then tell them to watch the insects to find out how they walk, how they jump, how they fly.

The next day correct and supplement their observations.

Give each child a hektograph drawing that he may clearly understand the beautiful adaptation of the legs and wings to their work. Give them other questions to guide them in their observations of the living animals. What do they eat? How do they eat? Can they see?

How do they see? How do they breathe? How do they sing?

The life history may be taught by means of hektograph drawings, or it may be left until late spring, at which time it is possible to obtain living material.

To the same order belong the crickets and katydids. The main difference between crickets and locusts is in the legs, the sound-making apparatus, and the ovipositors. The katydids are green in color, live in trees, and have longer antennæ and ovipositors.

1. Mr. Cricket. 2. Mrs. Cricket. *a*. Egg placer. *b*. Sounding apparatus.

Because the children may bring in specimens of dragon flies and cicadas (commonly and incorrectly called locusts), the following facts are given with reference to them.

Dragon Flies:

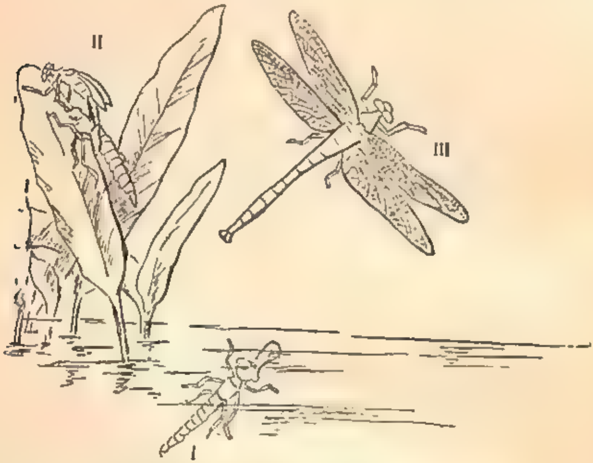
The adult dragon fly has a large head with large, brilliant, gemlike eyes. The head moves very freely in every direction, as indeed it must to see and catch its food, the lively mosquito.

The wings are nearly equal in size and texture, delicate, beautiful in color, often with a metallic lustre.

The long slender abdomen is chiefly used in steering.

To its peculiar appearance is doubtless due the popular name of devil's darning needle, and the popular superstition, that the chief reason for its existence is to sew up the lips and ears of naughty children.

Because of the nature of their food, they are always found near water, where, indeed, the young dragon flies live an active existence for a long time before becoming adults.

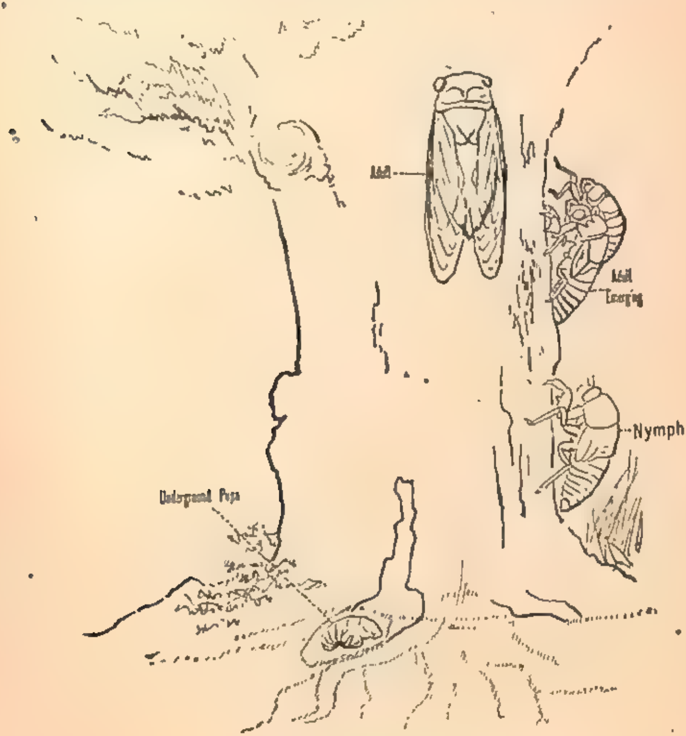


Life history of the Dragon Fly. I. Larva with the mask extended. II. Moulting of the pupal skin. III. Adult.

The eggs, dropped into the water by the mother, hatch out into wingless larvæ with a huge lower lip, which, when the insect is at rest, folds over the other mouth parts. It is capable of great and sudden extension and armed with a pair of pincers. The larva is so voracious that it is often called the water tiger.

When about to change to the adult form, the nymph, which is very like the larva and produced from it by moulting, climbs out of the water with the aid of a plant; the

skin splits along the back, and from this opening the dragon fly, with wet and crumpled wings, emerges. In about an hour these are spread and dry, and the dragon fly begins its comparatively short, terrestrial career.



The Cicada or Harvest Fly.

CICADA (Harvest Fly):

The cicada is neither a fly nor a locust, but a bug. Bugs are always easily recognized by the mouth parts, which form a long slender beak.

The male cicada is easily distinguished from his mate. He has a pair of drums on the under side of his abdomen. With these he sounds his loud call so often heard in the hot days of August. The female cicada has a long sword, with which she punctures holes in twigs of trees and there deposits her eggs. The larvæ hatch out in about six weeks, drop to the ground, and immediately begin to dig their way downward, using for this purpose their broad shovel-like fore legs. For more than a year and a half they remain contentedly in the earth, their beak piercing the roots of the tree and sucking its juices. After changing to a so-called pupa state, they burrow their way upwards, grasp tightly any convenient support, such as rails of fences or trunks of trees. The skin of each splits along the back, and from the opening emerges the adult form, which, after spreading and drying its wings, flies away, again to repeat the history of its race.

One well-known species spends seventeen years underground, and still another, thirteen.

The cast-off nymph skins are very common, and often found by children.

Beetles:

The commonest beetles are ground beetles, usually found in abundance under stones. They may be so kept in the schoolroom. A potato plant, infested with the brown and yellow striped potato beetle, often erroneously called a bug, may be kept in the schoolroom, and is sure to show not only the adults, but the eggs and grubs. The last will bury themselves in the ground, and there live a quiescent life as a pupa for the whole winter, if you secure a last crop. During the summer, however, the change from egg to grub, to pupa, to the adult beetle,

occupies not more than a month. Fireflies, lady bugs, and the borers with their long antennæ are also very commonly met with.

In general, the beetles have small heads which give them a wedge shape, well adapted for boring and digging.

Potato Beetle.

The wing covers are very hard and horny, usually covering the entire abdomen and meeting in a straight line in the middle of the body. The antennæ are sometimes thread-like, but there is also a great variety of other shapes. The legs are nearly equal in size. The development is markedly different from that of the locust. From

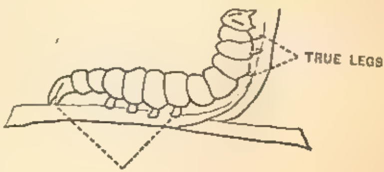
the eggs are hatched grubs, — caterpillar-like animals, — except that they have only three pairs of legs. They are voracious eaters, often doing great damage, and after various moults hide themselves in the ground and there quietly undergo the great changes which make of them the adult animals, very unlike the grubs.

A common Lightning Beetle.

Most of the other statements with reference to the locust hold true in the case of the beetle.

MOTHS and BUTTERFLIES:

The caterpillars of moths and the butterflies are most common in the fall of the year. All caterpillars should be placed in vivaria with moist earth and plenty of food. This food is the leaves of the plant on which they were found. In September, caterpillars are usually full grown, and speedily dig their way into the ground, there to spend the winter, or else they weave for themselves a cocoon, which protects them from both cold and wet. The common Isabella moth caterpillar, reddish-brown and black, remains fairly active all winter. Doubtless its thick, rather long hair protects it sufficiently.



Caterpillar.

Hektograph drawings of whatever caterpillar is brought in should be made and used for study after the children have been led to observe what and how it eats, how it moves, how it breathes. There is a head without compound eyes and with stout jaws, succeeded by thirteen body segments, on the first three of which are

three pairs of true legs. Further back are four pairs of prop legs, and, on the last segment of all, still another pair.

The commonest butterfly is the white cabbage butterfly, which is frequently seen even in city streets. As the name indicates, the caterpillar of it feeds on cabbages and

Mr. Cabbage Butterfly, Mrs Cabbage Butterfly, and chrysalis.

does them much harm. In default of anything better, one of these and a hektograph drawing of the same for each child will serve to show the peculiarities of its class.

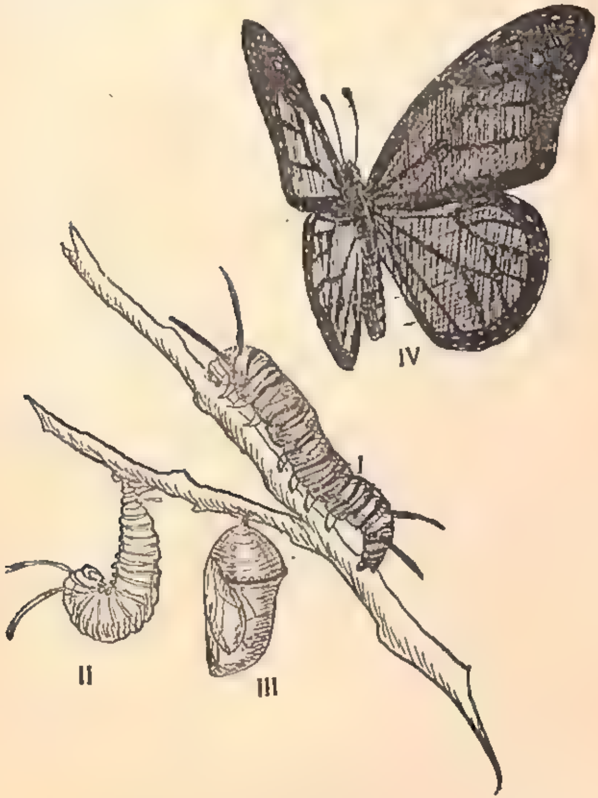
Like all butterflies, except the skippers, it has knobbed feelers, large compound eyes, and a coiled tongue on its head, and a chest to which three pairs of legs and two pairs of wings are attached. These wings are covered with scales, and are held vertically when the insect is at rest. Usually, therefore, the under side is less conspicuously colored than the upper. Still, it must be remembered that a dull-colored butterfly would be more noticeable than a brighter one when feeding on brilliant flowers. The cabbage butterfly, which is now one of our commonest, was not known in this country until just before the Civil War; but it found here conditions so favorable for its development that it is now encountered all over the United States.

Swallow-tail butterflies, the Mourning Cloak, and the Milkweed or Monarch, as it is often called, are larger, more beautiful, and more interesting, if they can be ob-

Mourning Cloak Butterfly on Willow. I. Larvæ. II. Chrysalis. III. Adult.

tained. All three of these are easily tamed, and may be kept alive for some time if fed carefully on syrup. The milkweed butterfly is said to migrate like the birds. At any rate, large flocks of them are frequently found resting on bushes and trees in the early fall. The males are

easily distinguished from the females, by the fact that they have pockets on their hind wings, in which are kept the

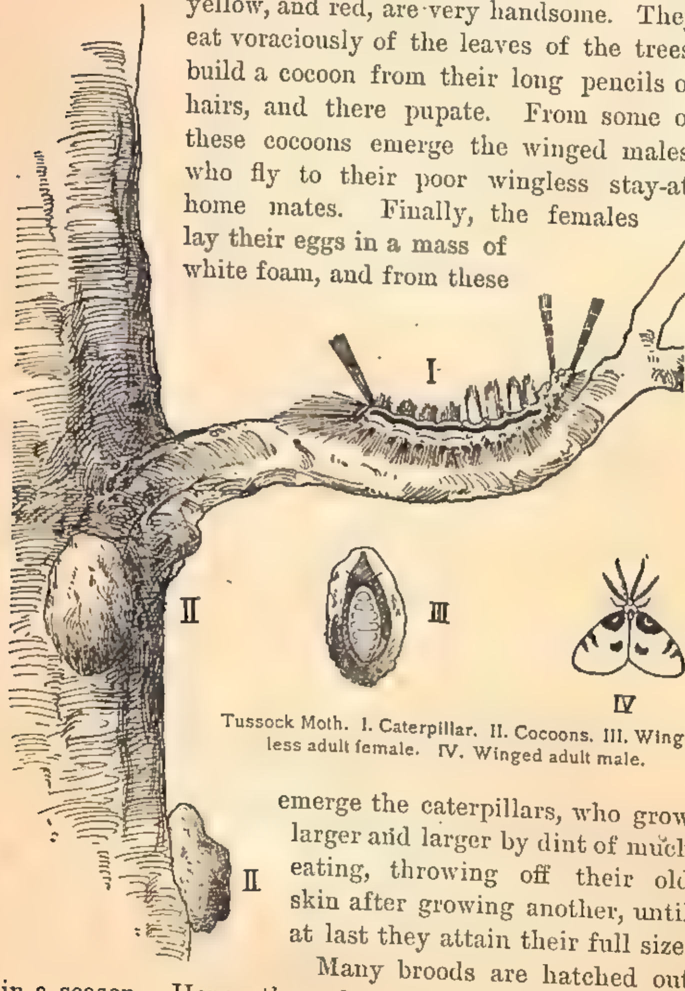


Milkweed or Monarch Butterfly. I. Caterpillar. II. Caterpillar changing to chrysalis. III. Chrysalis. IV. Adult.

scent scales, by means of which they lure the female, flying before her and saying, "See how sweet I smell."

The tussock moth is unhappily commonly found in all

of its stages in many kinds of trees, to which it does great damage. The caterpillars, in their livery of black, yellow, and red, are very handsome. They eat voraciously of the leaves of the trees, build a cocoon from their long pencils of hairs, and there pupate. From some of these cocoons emerge the winged males, who fly to their poor wingless stay-at-home mates. Finally, the females lay their eggs in a mass of white foam, and from these emerge the caterpillars, who grow larger and larger by dint of much eating, throwing off their old skin after growing another, until at last they attain their full size. Many broods are hatched out in a season. Hence the only way to exterminate them



Tussock Moth. I. Caterpillar. II. Cocoons. III. Wingless adult female. IV. Winged adult male.

us by waging against them a relentless war, taking particular pains to destroy finally all of the winter eggs.

BEES:

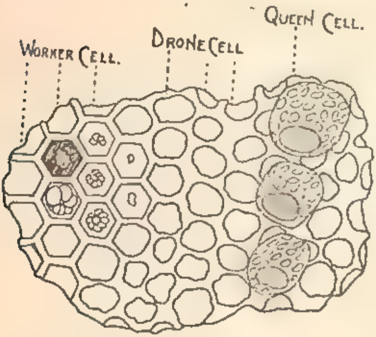
Certainly these should be studied in connection with the flowers, among which the children have found them. It is impossible to keep them happily in the schoolroom for more than a day at a time. An observation hive in the yard would give to each child an opportunity to see every stage in the most interesting life of the honey bee. Such a hive may be purchased from any apiarist, and would cost from seven to ten dollars. With this hive, the whole history of the bee may be studied in the fall; without it, it would be better to take up the life of the hive in the spring, and to consider only the worker bee in the fall.

As a matter of convenience, however, the life history of both the humble and honey bee are given here:

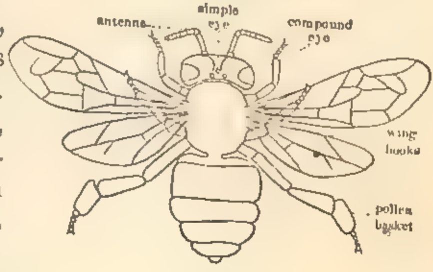
The queen is the fertile female, whose chief duty it is to lay the eggs; the drones are the males; and the workers, females who lay eggs only under exceptional circumstances, but who do all the other work of the hive.

The humble bees are social in their habits. The whole colony dies off on the approach of winter, except the impregnated queens. Each of these hibernates, and, on the first approach of spring, looks for a home, choosing sometimes a deserted mole's nest, but oftener a convenient place in the ground, where, of any available material, — horse hair, grass, moss, — she constructs a nest, and, in a mass of pollen and honey, lays her first eggs. These hatch out into workers. The empty cocoons serve as storehouses. Later, are hatched workers capable of producing drones, then drones, and, last of all, the queens.

In the spring, a hive of honey bees contains only a queen and comparatively few workers. This queen begins again the great business of her life of laying eggs. She chooses the smaller cells, which compress slightly the abdomen, so that the eggs, in passing down, come in contact with the spermatic fluid given her by the drone and stored in a special receptacle. This fertilized egg, in four days, develops into a white, footless larva, which floats in the food left in the cell, and is later fed by the nurses with a mixture of pollen and honey specially prepared in the crop. The nurses seal up the full-grown larvæ after six days, with a cap of wax. The larva spins a cocoon of silk, and gradually develops into the adult form. In eleven more days, assisted by the workers, she gnaws open her prison, acts for a week or so as a nurse for the others, and then takes upon herself the labor of ventilating the hive, gathering honey, pollen, and propolis. The workers have a longer tongue, very large hind legs with pollen

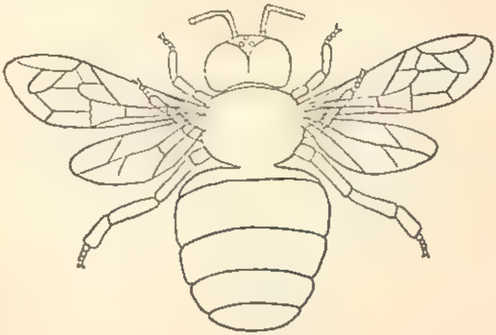


Honeycomb, showing the different cells and larvae in various stages of development.



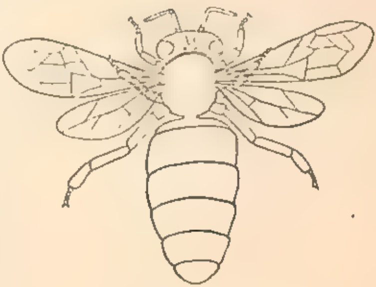
Worker.

baskets, and, on the under side of the body, six pockets, from which may be excreted flat plates of wax. They



Drone.

are particularly well fed and hang together like a curtain, when it is necessary to produce this substance. As it is formed, they pass it to the mouth and make of it a small pellet.



Queen.

Later, the queen lays eggs in the larger cells. These eggs are not fertilized, and hatch out in twenty-seven days into drones, the males, characterized by larger compound eyes and no sting. They do not work, and are killed off in times of famine, and, in any event, die after they have fertilized a queen.

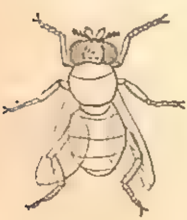
The queens are hatched from larger cells in sixteen

days. They have been abundantly fed on royal jelly, and are not allowed to escape until the sound of their voice ("piping") makes it certain that they are mature. Meanwhile, they are fed through a hole. Then the old queen and some of the workers, gorged with honey, leave the hive for a new home. This is called "swarming." If there is more than a single queen, they fight for supremacy, using their stings. The victor takes her nuptial flight, and returns to lay eggs to replenish the hive, often at the rate of three thousand a day. Their sense of sight and of smell is very acute. They prefer blue to other colors. They appear not to hear sounds other than their own. Wonderful as they are, however, Lubbock says that bees are less wise than ants.

The life history of wasps, hornets, and ants is similar to that of the bees. Space cannot be given to them here, but no one should attempt to teach them without thorough preparation.

FLIES:

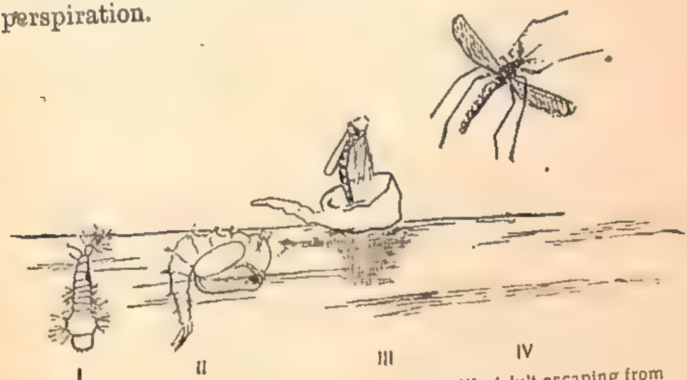
The house fly has but one pair of wings, although close examination shows a small pair of winglets that at first sight appear to be separate, although they really belong to the wings proper. These wings vibrate very rapidly, hundreds of times a second, making in the air the figure 8. With them move also the balancers, short-knobbed threads, occupying the place of a second pair of wings, and supposed to be modifications of them. They are probably organs of hearing or breathing. They may be seen more easily by examining the fly from the under side.



Fly

The feet are armed with two claws, between which is a pad covered with hairs, which secrete a kind of mucilage, thus enabling the fly to walk with ease on a ceiling. With its claws it can hold to rough surfaces.

The under lip of the fly makes the thick tongue, whose broad, knoblike end can divide into two flat parts each with a rough surface. Of these we are unpleasantly conscious when, on hot days, he endeavors to lick up the perspiration.



Story of the Mosquito. I. Wiggler. II. Pupa. III. Adult escaping from pupa skin. IV. Adult.

The eggs are laid in manure and hatch into maggots, footless, worm-like larvæ, which after a while wrap themselves up in a brown case, from which they emerge adult flies. This happens many times during the summer. When winter approaches, a few, by hiding in protected places, manage to survive until spring.

Mosquitoes:

These insects belong to the Fly or Two Winged Family (*Diptera*), but in their life history they more closely resemble the dragon fly.

The eggs are laid in a boat-shaped mass, from the under side of which the larvæ, called wigglers, escape. They lead an active life, moult several times, becoming at last large-headed pupæ. From these the adults emerge, using the cast-off skins as a boat, until the wings are dry enough for them to fly away. Since the least motion would upset the boat, we never have mosquitoes unless there is somewhere near still water.

The male mosquito is short lived and does not bite.

Methods:

A general method for the study of insects has already been outlined on pp. 42–45, under the head of *Method*, and can be pursued with any of the insects described above.

It is taken for granted that no teacher will attempt to study half the insects mentioned, even in the two fall months in which they are abundant. The facts about them are given in one place merely as a matter of convenience, and because it is impossible to tell what material may happen to come to the individual teacher.

LITERATURE

Myths, Legends, Stories:

Aurora and Tithonus (Grasshopper).
Madame Arachne (Spider), Celia Thaxter.
Not Lost But Gone Before (Dragon Fly), Mrs. Gatty's Parables from Nature.
Dragon Fly (and other aquatic insects), Water Babies, Kingsley.
Bees' Pockets, Wiltse's Kindergarten Stories.
King Solomon and the Bees, told in verse by J. G. Saxe.
King Solomon and the Ants, told in verse by Whittier.
The Musician and the Dancer, Stories from Fairy Land.
Ant and the Grasshopper, Æsop.

The Beetle that Went on his Travels, Andersen.
King and the Locust, Book of Tales.
Butterfly, Andersen.
Waiting (Cricket),
Law of Authority (Bee, Butterfly),
A Lesson of Faith,
} Mrs. Gatty's Parables from Nature.
Goddess of the Silk Worm, Emilie Poulsson's In the Child's World.

The readers are full of stories of the metamorphosis of animals.

Easy Poems:

Spider and the Fly, Mary Howitt.
Spider and the Fly, Alice Cary.
The Secret, Mrs. Dodge's When Life is Young.
Grasshopper Green, Walker's Songs and Games.
To a Honey Bee, Alice Cary.
Seven Times One (one verse, the Bee), Jean Ingelow.
The Busy Bee, Isaac Watts.
Song of the Bee, Marian Douglass,
Butterfly,
Butterfly's Lesson,
Lady Bug,
Maude and the Cricket,
} Lovejoy's Nature in Verse.

More Difficult Poems:

Ode to a Grasshopper, Leigh Hunt.
Grasshopper, Tennyson.
Extracts from Humble Bee, Emerson.
To a Butterfly, Wordsworth.
Cricket, Cowper.
Grasshopper,
Lady Bird,
} Lovejoy's Nature in Verse.
Hen and the Honey Bee, J. G. Saxe.

CHAPTER II

OCTOBER.

Easy Poems:

October Party, Lovejoy's Nature in Verse.
Autumn Song (October), E. C. Stedman.
In Time's Swing, Lucy Larcom.

More Difficult Poems:

October's Bright Blue Weather, Helen Hunt Jackson.
October, Bryant.
October, Wordsworth.
October, Longfellow.
Under the October Maples, Lowell.

Easy Autumn Poems:

The Autumn Winds are Crying, Eleanor Smith's Songs Little Children.
The Seasons. Lovejoy's Nature in Verse.
Faded Leaves, Alice Cary.

More Difficult Poems:

Autumn Wood,
Extract from Death of the Flowers,
Voice of Autumn,
Extract from Song of the Sower, } Bryant.
Indian Summer,
Extract from Last Week in Autumn,
St. Martin's Summer, } Whittier.

The͏e work for October should continue the study of the
Kin͏d and clouds, the flowers and insects, and begin the
Bu͏ly of fruits, and of the Eng-
Wa Sparrow.
La
A I
Go WEATHER
Sun.

T͏*st and Second Years:*

of a͏*ths:*

Eas he Wanderings of Latona.
Apollo and the Python.
SApollo and Clytie.
SHyacinthus.
TPhaethon.
GIris.
T

Niobe.

SThe myths named above give
Te story of the sun god, the
Sver of light and heat: Light, triumphant over Dark-
ss, is typified in Apollo's struggle with the Python.
he desire of plant life for the sun is told in the story
Clytie. The blooming vegetation of spring withering
der the heat of summer is the meaning of the story of
M Hyacinthus. The destructive drought is the consequence
of Phaethon's careless driving of his father's chariot; and
the storm of thunder, lightning, and rain is the thunder-
bolt of Jupiter which destroys the daring rider. Finally,
comes the beautiful myth of Iris, the goddess of the
rainbow.

Lor these and other myths, Guerber's "Myths and
Hends," or Gayley's "Classic Myths," should be con-
Cook's "Nature Myths" gives several of them
r children.

Facts:

The sun is more than a million times larger than the earth, and more than ninety-one million miles distant.

We move around the sun, which sends to us light and heat by wave motions. The light and heat do a great deal of work for us. Without them it would always be

Latona and her children, Apollo and Diana.

bitterly cold and intensely dark. No rain could fall, no rivers flow, and neither plants nor animals exist.

The course of the sun varies. It rises in or near the east, sets in or near the west, and in the summer journeys higher in the sky than in the winter. Hence in summer and at midday the vertical rays reach us, and it is then hotter than in the winter, or in the morning or evening when, the rays being slanting, the heat and light are less intense in a given locality, since they cover a larger area.

Method:

Tell the sun myths in the way suggested for the myths of the wind and clouds.

Something has come very softly into the room, it is bright and yellow and warm. It has come from a great distance. Who can tell his name? From what has Mr. Sunbeam come?

What day is named for the Sun? Why?

How far is it to the Sun? So far that, if you were there and could speak loud enough for me to hear, it would take two weeks for the sound of your voice to reach me; so far that, if you told me to come to you on the fastest express that exists in the world, it would be about one hundred and seventy-five years before I could reach you, even if I travelled both day and night.

Apollo Belvedere.

Show in the same way how small the earth is in comparison to the sun.

Who has watched the light coming into the bedroom in the early morning? Does it come at the same time? At the same place? Why is it first gray, then lighter?

Yes, that is the way that it seems, but really we are travelling round the sun.

Illustrate this by causing a globe with a small portion of it covered with black court plaster to revolve around a lamp until at last the plaster catches the light.

Recall to their minds the similar phenomena familiar to them in the telegraph poles, fences, houses, which apparently rush by us as we gaze out of the windows of a moving car.

Phaethon driving Apollo's car.

What does the sun give us? How does it send us light and heat? Illustrate by throwing a pebble in water, by shaking the room or desk, by the voice. What good does the light do? heat?

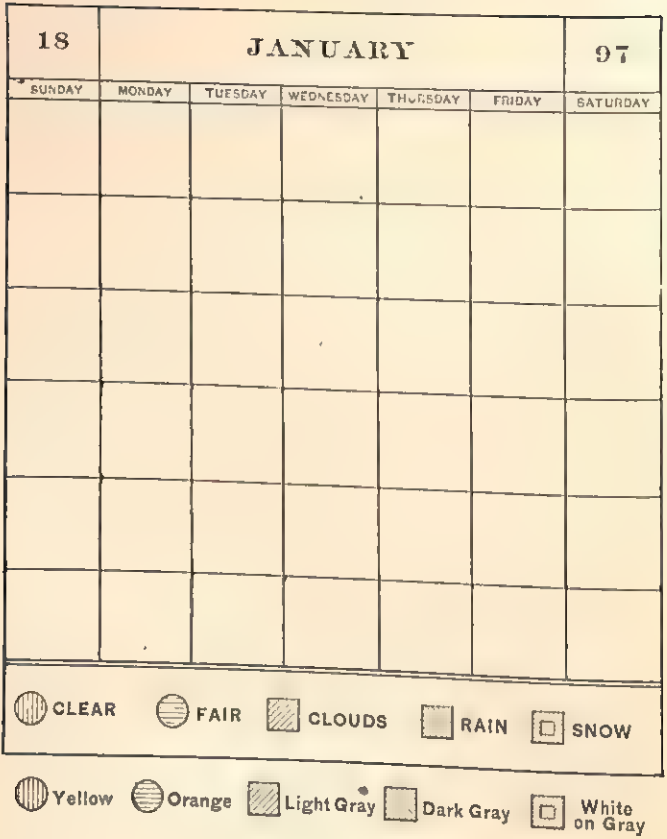
To determine the apparent course of the sun and the consequent daily and seasonal variations in temperature mark each week at same hour the distance which the sun shines into the room. This may be done by driving a tack in the floor. During December the sun will come farther and farther into the room until the twenty-second.

Iris.

Then for a few days it will be stationary. As the sun rises higher the path of the light shortens.

The Light of Life, Mrs. Gatty in "Parables of Nature," shows the necessity of light to plants.

Show light through a prism again and again, until the



Sunshine chart. (See p. 69.)

children can pick out the colors. When do we see rainbows in the sky? Why?

Show the heat of the sun's rays with a burning glass, which may be made to set paper afire.

A pretty illustration of the work of the sun in photography may be made by putting a leaf in a printing frame

on blue print paper in the sun. By the end of the lesson the print will be ready to wash in clear water, giving a permanent photograph of the leaf.

A daily chart of the sunshine may be kept by taking a piece of Bristol board, printing the name of the month above, dividing the remaining space into thirty-two squares, and by pasting in the appropriate square each day a gummed color such as are used in kindergartens. Jackman suggests light yellow for sunny days, orange for fair weather, light gray for cloudy days, dark gray for rain, and the same with a white centre for snow.

Of course, the daily observation of the wind and clouds should be continued with frequent excursions.

LITERATURE

The myths have already been given.

Sunshine Stories, Andersen.

Easy Poems:

I Had a Little Shadow,
Good Morning, Merry Sunshine, } Eleanor Smith's Songs for Little Children.
Sunshine,
The Sunbeams, Emilie Poulsson's In the Child's World.
Water Bloom (Rainbow), Celia Thaxter.
Sunbeams,
Little Sunbeam,
The Sunbeam, } Lovejoy's Nature in Verse.
Four Sunbeams,
Sunshine,
Good-night.
If I were a Sunbeam, Lucy Larcom.
Sunny Days, Mrs. Dodge's When Life is Young.
Sunbeams, Mrs. Hemans.
A Day of Sunshine, Longfellow.

WEATHER RECORD, No. I

NOTE. — This should be printed on paper 8 in. × 12 in., to give sufficient space for children's writing.

Name, ...

.... *Grade.*

.... *School.*

Wind Record for the Month of ....*18*....

Observations made at ....

DATE	DIRECTION	VELOCITY	DATE	DIRECTION	VELOCITY

What has been the prevailing wind this month? ....

Third and Fourth Years:

Frequent short excursions to continue the teaching of the names and appearance of the clouds, and to verify their daily observations on the wind, should be taken.

The use of Weather Record, No. I. (see opposite page), should begin on the first of October. Each child should record her observations, without discussion, the first thing in the morning. After the papers have been collected, then the teacher, or, better, one of the children, should record the facts on the board. Then may follow the discussion.

It will be sufficient for the class as a whole to make this record once a day, but the blackboard record should be made up of at least two observations, perhaps three, made at stated times during the day.

Insist upon neatness and accuracy in this work, but do not allow it to degenerate into mere routine. When there are obvious relations between the wind and the weather, such as an east wind bringing rain, a cold north wind, or a warm wind from the south, point them out.

Think yourself, and make the children think.

PLANTS

In addition to such fruits as may be found on the trees in the neighborhood, all grades should study, from the point of protection and distribution, the Chestnut, the Apple, either Burdock burrs or Stick-me-tight, and either the Maple, Ash, or Ailanthus.

Chestnut Burr.

Facts:

The long white catkins of the chestnut appear in late June and early July. They have a strong, rather disagreeable, odor. The flowers at the tip contain the sta-

mens, while those with the pistils, if found in the catkin at all, are at its base. There are usually three pistillate flowers, surrounded by green, prickly involucre. After fertilization, this involucre keeps pace with the growth of the two or three fruits within, easily protecting them from all enemies by reason of the prickles. The burrs themselves, at the ends of the branches, bright yellowish green in color, stand out sharply against the dark-green foliage. In the fall of the year, after frosts, they drop to the ground, and show within a beautiful plush-like, four-parted cup, holding from one to three nuts, each bearing at its tip a withered pistil. When there is more than one nut, the contiguous sides are flattened, but the sides toward the involucre are, of course, convex.

Chestnut. Three young chestnuts in the burr. Open burr.

The wind, squirrels, and small boys help to distribute the chestnuts, which would otherwise exterminate each other, since, if all germinated around the parent tree, neither soil nor space would be sufficient for their development.

The fruits, or nuts, well protected from cold and rain by the thick, shiny, brown coat, live quietly through the winter, not beginning to sprout until the coming of spring promises them a warm period sufficiently long to enable them to attain a hardy growth before the approach of a second winter.

In the nuts are often found worms, whose existence

within is something of a puzzle; for, while it is not difficult to find the hole by which they leave the chestnut, no one can see how they got in. The chestnut-borer, a beetle, bores a tiny hole in the nut, and deposits therein her eggs. These eggs hatch out into footless grubs that eat their way out of the chestnut by means of strong jaws, which move vertically, instead of sideways like those of other insect larvæ. These grubs pupate in the ground, emerging thence full-grown weevils, which repeat the egg-laying process with the same results.

Chestnut Weevil.
Chestnut Grub.

The tree itself is one of the largest and tallest of our forest trees and a very rapid grower. Because of this, while the young bark is remarkably smooth, the bark of the trunk is hard and rugged, with deep clefts. It has split repeatedly in order to accommodate the growth within.

The leaves are long and very lovely in texture and in color. The wood makes valuable timber. It is both durable and beautiful, admitting of a high polish.

It makes a profitable orchard because of its quick growth and the demand for its fruit. From it, in southern Europe, is made a flour much used by the poorer people.

The chestnut tree attains a great age and size. On top of Mount Ætna is a famous tree called the Tree of a Hundred Horsemen, from the fact that it once sheltered a hundred cavaliers.

Method:

By means of material supplemented with blackboard drawings, show a series illustrating the story of the de-

velopment of the nuts, beginning with the three little flowers in the prickly involucre, then the closed burrs, and open burrs with one, two, and three nuts.

Look at the inside and the outside of the burr. What difference in their texture, and why? When is the burr closed? Why? When does it open? Why? Look at this burr with only one nut, and at this with two. What difference in the shape of the nut? Why? Look at the burr with three nuts. Which is different from the other two? Why? Distribute nuts. Can you tell whether your nut was an only child, or whether it had one or two brothers? Why?

If we plant the nut, what may it become? What color is the coat? What advantage is it to the nut to be brown? to be shiny? to be thick? Why is it better for the nut to be quiet all winter, not even beginning to grow until spring?

What is the meaning of the large scar? What was the slender tip? What is inside the nut? As they eat it, tell them of its use in other countries.

Wormy chestnuts, hektograph drawings of the chestnut-borer and its grub, will be needed for a second lesson.

How many find holes in their chestnuts? Describe it. Open your nuts. Who can tell what made the hole? Why do you think so? What is the soft powder? How did the grub get in the chestnut? How will he get out? Why does he want to get out? What becomes of him finally?

It may be desirable to give the children some idea of the tree itself and its economic uses. This may best be done by taking them to see a tree. The next best thing is to bring them leaves and branches.

Show them the wood and tell them of its uses.

Apple, flower and fruit.

I. Branch, showing flowers and leaves. II. Vertical section through the flower. III. Flower after the petals have fallen. IV. Green apple. V. Vertical section, showing thickened calyx and ovary. VI. Cross-section of the same.

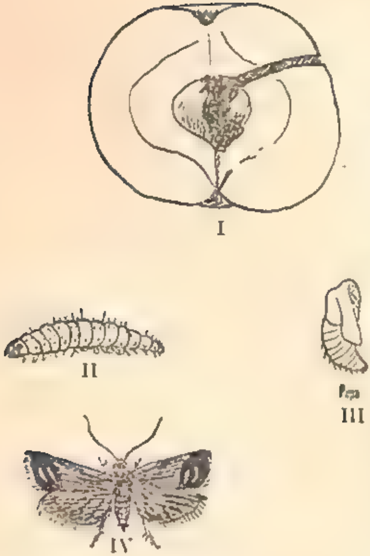
APPLE.

For facts, see p. 241.

Method:

This is sufficiently well indicated in the paragraph on the Chestnut.

Blackboard or hektograph drawings of the tree in spring, of a single flower, a small green apple, and vertical and cross sections of the ripe apple should be used to supplement the material.



Work of the Codlin Worm. Larva. Pupa. Codlin Moth.

BURDOCK BURRS (Arctium lappa).

Facts:

This plant which belongs to the Composites is very commonly found in waste lots. The flowers are purple, rarely white, in color, and surrounded by an involucre, each scale of which is tipped with hooks. These, by catching in the clothing of man, or attaching themselves to other animals, serve to distribute the fruit.

Burdock

Method:

Both the necessary material and

manner of using it have been sufficiently indicated in the paragraphs on the Chestnut and Apple.

STICK-ME-TIGHT, BEGGAR'S LICE (Bidens frondosa).

Facts:

This common and troublesome weed belongs to the same family, and distributes its fruits in the same way. The flowers are yellow.

Stick-me-tight.

Method:

Both the necessary material and the manner of using it have been sufficiently indicated in the above paragraphs.

MAPLE, ASH, AILANTHUS.

Facts:

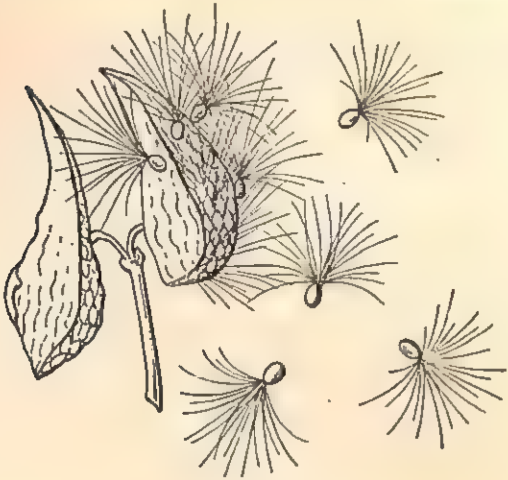
Many maples ripen and distribute their fruit in the spring, but others, the sycamore maple for example, retain the keys until fall. If they can be obtained, these keys will serve excellently to show fruits distributed by the wind. The ash or ailanthus will answer equally well. The fruits of the dandelion, thistle, and milkweed illustrate the same point. For facts with reference to maple and ailanthus trees, see pp. 218–222.

Ailanthus, fruit.

The ash is among the most graceful of trees and the most useful. Its wood resembles the chestnut and oak in appearance, but is lighter in color, and not so beautiful. It is elastic, hard, and strong.

Method:

It would be an excellent plan to let the children have



Milkweed seed.

a number of fruits, like the ailanthus, ash, and maple, and note their resemblances and differences.

Maple.

Ash.

All of them agree in the fact that they are fruits, and that the seed within is carefully protected; all have wings. What good is this to the seed? What other fruits are distributed by the wind?

At the conclusion of these lessons the children should be given an oral language lesson, to crystallize the general ideas which they have obtained of the many ways by which plants protect and distribute their seeds.

LITERATURE

Stories:

How West Wind Helped Dandelion, | Emilie Poulsson's In the Child's World.
Little Chestnut Boys, | Emilie Poulsson's In the Child's World.
Sleeping Apple, | Emilie Poulsson's In the Child's World.
Dandelion Clocks, Mrs. Ewing.

Easy Poems:

Dandelion Fashions, | Eleanor Smith.
Milkweed Babies, | Eleanor Smith.
Dandelion Cycle, Emilie Poulsson's In the Child's World.
Dandelion, Kate Brown, in Lovejoy's Nature in Verse.
Dandelion's Complaint, St. Nicholas, August, 1897.

More Difficult Poems:

Apple Seed John, Lydia Maria Child, in Emilie Poulsson's In the Child's World.
Planting of the Apple Tree, Bryant.
Bitter Sweet (Cellar Scene), Holland.
The Fruit Gift, Whittier.
Maple, Lowell.
Winged Seeds, Helen Gray Cone, in Lovejoy's Nature in Verse.
Dandelion, in Four Winds, Hiawatha.

Prose:

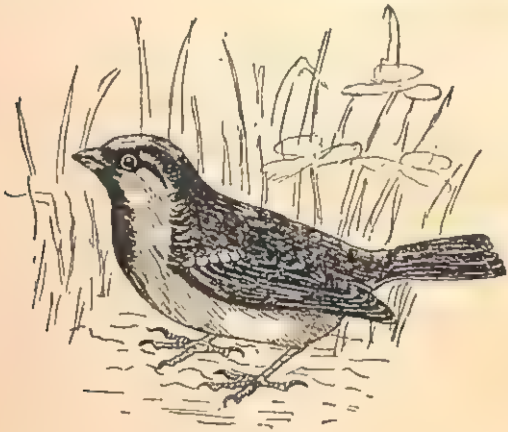
The Apple (Winter Sunshine), Burroughs.
Seed Tramps, Sharp Eyes, Gibson.

ANIMALS

English Sparrows.

Facts:

The male sparrow may be instantly distinguished from his mate by the white bar on his wings and the black mark on his throat and breast. The female is duller in



English Sparrow, male.

color, and the young birds, regardless of sex, resemble her. This difference in color between the sexes is even more marked in many other birds, and is variously accounted for. Darwin believed that it resulted from sexual selection, the female choosing for her mate the most brilliantly colored of those who courted her, thus perpetuating this characteristic. Wallace, on the contrary, believes that the more brilliantly and conspicuously colored females have been destroyed, thus continuing only the race of dull-colored ones. Others think that

the brilliant coloring of the male is the visible expression of his greater activity.

The beak of the sparrow is a cone, the line of the mouth drooping characteristically downward. It is strong, well adapted to crushing grain, yet delicate enough to pick up small objects. The feet are typical of the percher, four slender toes, three in front and one behind.

In the cities it nests preferably in protected corners of buildings, but since there is not, nowadays, a sufficient number of such places for the innumerable sparrows, they have learned to build nests in the trees. These nests serve not only for breeding purposes, but also as places of shelter during the colder winter months. In this latitude (Philadelphia) they begin to lay eggs in March, and the young are quite numerous on the ground in May.

The eggs are bluish gray, speckled with brown; five or six in the large feather-lined nest. The mother bird usually occupies a week in dropping the eggs, two weeks in hatching them, another in feeding the young birds in the nest, and still another in feeding them outside. Probably about four broods are raised in a season.

They eat all kinds of vegetable food, feeding particularly on the half-digested grain found by them in the horse droppings of city streets, on buds, on a few insects, but never on hairy caterpillars.

They are quarrelsome, unclean, and have partially or wholly exterminated many of our more valuable native birds. Nevertheless, since by their enormous breeding capacity they are now with us to stay, let us get what we can out of them by studying them with the children.

Perhaps those whom we thus educate will be more intelligent than those who in the early fifties started the sparrow "boom" by importing and protecting numbers of these birds from England and Germany under the impression, biologically absurd, that a conirostral bird could rid a country of insect pests.

Method:

Study the birds yourself until you are quite sure of the facts.

Take the children out of doors. Tell them that Mr. Sparrow wears prettier clothes than Mrs. Sparrow, and ask them to pick out, if they can, Mr. and Mrs. Sparrow, and to notice the appearance of each.

Although the sparrows are remarkably fearless and tame, it will be necessary to caution the children to keep at some distance and to observe quietly.

At this time of the year corn, bread crumbs, or bird seed, scattered round shortly before the children are sent out, will be sufficient inducement to bring within range of their vision all the sparrows of the neighborhood.

When the children return from the excursion, distribute hektograph drawings of the male sparrow. From these obtain a description of the bird.

How many saw birds like this? What was the color of the throat and breast? How many saw clear white markings on the wings? How many saw sparrows without the black on the throat or the white on the wings? Were they young or old birds? Then tell them which were Mr. Sparrows, which were Mrs. Sparrows, and which were the children.

Tell them to watch to see what else the sparrows eat.

Call for an answer to this question several mornings in succession.

Take them out a second time to see if they really do know the difference between the male, female, and young birds.

Do they run or hop?

With Pictures:

Why would it be difficult for the sparrow to run? What are its feet good for? Why? When does it perch? Why is it better for birds to perch at night rather than to sleep on the ground? How does the bill of the sparrow differ from the bill of the robin? Why? From the crow? Why? Where are its nostrils? Can it hear? Why do you think so? Where are its ears?

Look at its forehead, eyes, nostrils, mouth, ears. Are they arranged like yours? To what, then, do the wings correspond?

If possible, find nesting places in the vicinity of the school, and take the children to them. Bird-houses, holes in trees, eaves of buildings, are the most likely places in which to seek for them.

Get a nest, and let them see of what diverse materials it is built. Why?

LITERATURE

The various readers and bird books may be used, although there is very little in any of them with reference to the English Sparrow itself, and, indeed, most of the usual bird stories will be more appropriate to spring study.

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Birds' Nests, Gibson's Sharp Eyes.
Birds' Nests, Burrough's Wake Robin.

Poems:

Bird Thoughts, Emilie Poulsson's In the Child's World.
The Sparrow's Nest, Mary Howitt.

CHAPTER III

NOVEMBER

Poems:

November, Thomas Hood.
November, Alice Cary.
November, Bryant.
A November Day, Whittier.

THANKSGIVING (Harvest Home).

Stories:

A Boston Thanksgiving, E. E. Hale. Emilie Poulsson's In the Child's World.
The First Thanksgiving, Mrs. Wiggin's, and Miss Smith's The Story Hour.
Thanksgiving Story, Wiltse's Kindergarten Stories.

Poems:

Thanksgiving Day, Can a Little Child Like Me, } Walker's Songs and Games.
Harvest Song, Thanksgiving Hymn, } Eleanor Smith's Songs for Little Children.
Thanksgiving Day, Lydia Maria Child in Whittier's Child Life.
The Pumpkin, For an Autumn Festival, } Whittier.

WEATHER

FIRST AND SECOND YEARS:

In addition to a continuance of the study and observation of the wind, clouds, and sun, the study of the moon may begin.

Facts:

The moon is comparatively and varyingly near us, and much smaller than the earth. It revolves round us, taking about twenty-nine days to accomplish its journey. It has never shown to us but the one side. It shines by light reflected from the sun. Light reflected back from the earth causes the appearance popularly known as "the old moon in the new moon's arms," the outline of the unillumined portion of the moon visible a few days before and after the new moon.

Phases of moon.

By its phases are meant the various appearances which it presents in its different relative positions to the sun and earth. These phases are the new moon, the first quarter, full moon, last quarter.

The causes of these different classes below are best shown by the diagram.

The delicate crescent of the new moon, with its horns turned from the sun, rises in the west just after sunset. It soon sets. Each night it rises further and further towards the east, and sets correspondingly later. Finally

it reaches a point directly opposite the setting sun, and for this reason has its full half surface illuminated.

The full moon in the autumnal equinox rises about sunset for several days in succession, thus making brilliant moonlight nights. This is then called the Harvest Moon. The same thing happens in October. It is then called the Hunter's Moon.

After the full moon, less and less of the surface is illuminated. It rises and sets later and later, and at this time may be seen high in the western sky long after sunrise; so that those who feel that they must be able to show the moon in order to teach it, may take this opportunity to begin the lessons.

The various markings visible on the moon are caused by inequalities of its surface — the Mountains of the Moon. There are no clouds above it, and therefore no water on its surface, although there may be ice.

Although all nations see the same side and markings on the moon, their legendary interpretation has been very different. The Chinese saw a rabbit pounding rice; the Germans, a man carrying a bundle of fagots; the Icelanders, our own familiar Jack and Gill; and the Indians, according to Hiawatha, the grandmother of an angry warrior.

Method:

Why is it dark at night? Is it always dark? Why not? Which is brighter, the sun or the moon? Why? How far is the moon from us? Is it larger or smaller? Does it look larger or smaller than the sun? Why?

Has the moon always the same form? What different forms? Why? What makes the man in the moon? Is it warm or cold in the moon? Are there clouds,

water, air? Could people like us live in the moon? Why not?

What day of the week was named for the moon? Why? Why was the word month named for the moon?

What do the Chinese children see in the moon? The little people in Iceland? The Germans? The Indians? Why do the different children see different things?

Diana.

LITERATURE

Myths and Legends:

Greek, Diana and Endymion.

Chinese, Harper's Magazine, 1881.

Indian, Clodd's Birth and Growth of Myth.

Icelandic, Fiske's Myths and Myth Makers.

German, Fiske's Myths and Myth Makers.

Easy Poems:

Two verses from Seven Times One, Jean Ingelow.

Children in the Moon, Whittier's Child Life.

New Moon, Whittier's Child Life.

Silver Moon,
New Moon,
Baby and the Moon,
Who has the Whitest Lambkins? } Eleanor Smith.

Waning Moon, Celia Thaxter.

Endymion.

THIRD AND FOURTH YEARS:

Weather Records:

The weather record for October should be examined, and a record made, in the space provided for that purpose, of the prevailing wind.

If the excursions have been frequent enough and supplemented by proper teaching, the children will now know the names of all the common clouds that are likely

WEATHER RECORD, No. II.

NOTE.—This should be printed on paper 8 in. × 12 in., to give sufficient space for children's writing.

Name,--

--------------------------*Grade.*

--------------------------------------- *School.*

Weather Record for the Month of--------------------------- *18*---

Observations Made at-----------------------------

DATE	DIRECTION OF WIND	VELOCITY OF WIND	CLOUDS	DATE	DIRECTION OF WIND	VELOCITY OF WIND	CLOUDS

What has been the prevailing wind this month?--------------

Has it usually been strong or gentle?--------------

What kind of clouds have been commonly seen?--------------

to occur in November. They should therefore be given Weather Record, No. II., with its spaces, not only for the daily record of the wind, its direction, and force, but also for the names of the clouds. Instead of writing the names in full, they might now use the proper abbreviations, which are as follows:

Cumulus	cu.
Stratus	s.
Nimbus	n.
Cirrus	ci.

Mixed clouds, such as strato-cumulus, have for their abbreviation a combination of the two, in this case s. cu.

The teacher, at least, should now begin to watch the clouds with reference to their indications of future weather. She herself can best judge when is the appropriate time to teach what she learns, but certainly she should learn sometime during the year the following facts:

The commonest cloud form in summer is the cumulus. In winter stratus and cirrus clouds prevail. In autumn cirro-cumulus and alto-cumulus are most frequently seen; and in spring cirro-stratus and cirrus.

Slowly moving cirrus clouds indicate a probable slight change in temperature. If they are moving rapidly along, the chances are in favor of a decided change. This is likely to be a fall in twenty-four hours, especially when the wind is from the southwest. When the wind is northwest, on the contrary, there is likely to be a rise in temperature within twenty-four hours.

With cirro-stratus clouds there is some probability of rain; with alto-cumulus and alto-stratus, the likelihood is greater. Cirro-cumulus clouds indicate fair weather.

Obviously, even these few facts cannot be learned by any one in less than a year. They are merely given here for the convenience of the teacher, and will be referred to again when the occasion demands.

To do effective work it is absolutely essential that the teacher, even more than the children, should observe and think about the weather conditions.

I would again urge a set time for the daily written record by the children, and a few minutes immediately after this for a free discussion of the facts and their meanings.

TEMPERATURE:

Every schoolhouse should have, just outside the door, a large alcohol thermometer, so placed that the mark 50° is level with the eye of the medium-sized child.

It is worth while, if it be possible, to have a cheap thermometer for every other child. This, perhaps, can be managed by teaching the children in small groups.

Facts:

Heat causes the mercury to rise; cold, to fall.

A thermometer can only be accurately read when the top of the mercury column is on a level with the eye.

In the winter, north and west winds usually bring cold; south and east winds, warmth.

Method:

Make the children handle the thermometers without touching the mercury column. No teacher needs to be told that this demands from her clear directions and vigilance in seeing that they are obeyed.

Holding them in this way, let them describe the instrument.

Nearest what number is the top of the column?

Let them put their hands about the bulb. What is happening? Nearest what number is it now?

Let them put the bulbs in ice-water. What is happening? Nearest what number is it now?

What effect has heat on the column of mercury? Cold? Why? For what purpose is a thermometer used?

With a blackboard drawing, make clear to the children the exact value of each of the spaces. Give them considerable practice in reading from the board before using a large thermometer. Let several children read from this, holding it much below the eye, then on a level, then above the eye. Put these numbers, which will probably be in the ratio of 71°, 72°, 73°, on the board, and ask for the explanation.

In my own teaching, the children have always given as a reason that the heated air has expanded and ascended. Asked to think more about it, they came the next day fortified by the assurances of their fathers and grandfathers that this is the real explanation. So strong is their belief in the wisdom of themselves and their families that several demonstrations of the fact that the change was due to the position of the eye, and not to any change in the thermometer, were necessary to convince them of their error. To do this, keep the thermometer stationary while the child, by stooping, by standing erect, by standing on an elevation, sees that the reading varies with his position.

These lessons in accurate reading should be followed by the examination and criticism of the results of their daily inspection of the school thermometer.

Add a column for temperature in the blackboard record, and constantly call attention to the relationship between the wind and the temperature. By a record of observations, made at different times in the day, establish the fact that, ordinarily, the temperature rises in the morning, and continues to rise until about three in the afternoon, and then as gradually falls. Why is this?

After the lessons on temperature, teach the facts about the sun given on p. 64.

PLANTS

Obviously the preparation of plants for winter must be the subject for botanical work in November. This preparation goes on all summer, but the results of this labor are more markedly visible in fall.

Trees:

Long before the leaves begin to fall, a close observer may find buds containing, in miniature, the whole of next year's growth. These buds attain their full growth shortly before the leaves drop off.

Many are the devices by which the treasures within are protected. Numerous thick scales and woolly linings serve to keep some from the cold of winter, while a shiny outside, resin or gum, protects them from injury from rain cr melting snow.

The leaves themselves turn yellow, and the food which they have been making goes into the twigs and branches. The green chlorophyll which did the work becomes disorganized. To this is mainly due the yellow or red color of autumn leaves.

A new row of cells is formed, cutting across the stalk of the leaf. This causes the fall of the leaf. When the

frosts come, a layer of ice is here formed, which, melting and hence expanding, separates many leaves at one time from the branch.

These leaves have done much for the trees; in them have been effected the respiration and the digestion of the plant. But their good work does not end with their death. Decayed leaves (leaf mould) are a very necessary and valuable ingredient of the soil.

The tree itself is much better off without the leaves, since it is now too cold for them to do any work. Its food material will be more effectively protected in the branches, and it can stand more vigorously against the storms and snows of winter now that all superfluous clothing is removed from it.

Even the trees which retain their leaves make some preparation for winter. The green chlorophyll retires for protection to the innermost part of their leaves, which, in consequence, lose the vividness of their green.

Method:

Let the children compare the green leaves on the tree with those that are turning yellow, and also with those that have fallen to the ground. Take them out to collect the last material, and see that they get freshly fallen leaves as well as those which have already begun to decay.

Let them observe the change in color which precedes and follows the falling.

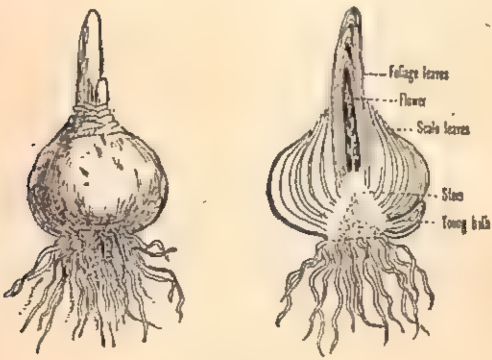
What work for the plant is done by the green of the leaf? What has become of all this food? Why has the leaf changed in color? What else has happened? Why do so many leaves fall after a frost? What good is the leaf after it falls from the tree? What advantage

is it to the tree to be without leaves all winter? From what trees do the leaves fall first? last? On what trees do the withered leaves persist? What is left to mark the place on the branches where the leaf was? Where are next year's leaves? When were these buds made? Why are they so small? Why is their coat shiny? sticky? Why has it so many coverings?

Bulbs and Fleshy Roots.

Facts:

All plants that survive the winter protect themselves in some way against cold, and also store up sufficient food to start their growth next year. The onion, hyacinth, tulip, die down to the ground, but not until they have formed beneath the ground a short, thickened branch on



Hyacinth bulb.

which are borne closely crowded leaves full of nourishment and covering over a perfect little flower or stalk of flowers. This we call a bulb.

It only needs a short period of rest in the cold, fol-

lowed by abundance of moisture and warmth, to convince it that winter has passed, that spring has come, and that it is now time to begin to grow. This is the method and philosophy of forcing bulbs into bloom in the winter.

Oftentimes the nourishment for the next season's growth is stored in the roots. Sweet potatoes, carrots, beets, turnips, are excellent examples of this. They, too, may be deceived into thinking that winter has gone, and that spring is here. One may cut the lower end from a carrot, scoop out some of the centre, keep it filled with water in a warm room, and watch, with delight, the green branches which insist upon growing upwards from the lower end.

Method:

A hyacinth bulb cut vertically in half shows perfectly the short thick stem, the numerous leaves, and the flower stalk within. Before showing this, ask the children the previous history of the bulb. They will know that there was a hyacinth in the spring with beautiful sweet-scented flowers and numerous green leaves, and that both have died long since. You will have to tell them that after the flower had passed away, the leaves worked with all their strength to make and to give food to little underground branches which are really just like little plants, except that they were not green.

Show the cut bulb, and, by drawing or otherwise, make them realize that it, too, has leaves and flowers. Ask them why the leaves are not yet green, why they are so small, so thick, why they are so compact and well covered? Ask them when this bulb will begin to grow and why? Will it grow now if we give it water and warmth?

Why not? How can we make it believe that winter has come and gone?

Either a hyacinth or a narcissus bulb should then be placed in a glass so that the lower end just touches water. Keep them for six weeks in a cool, dark place; or, better still, plant them in a pot of earth sunk in the ground, and covered with manure and straw to prevent a succession of freezings and subsequent thawings. At the end of six weeks, either the glass or the pot may be brought in the light and warmth, and will probably bloom within two months.

One is apt to have better luck with bulbs planted in a pot, but those growing in a glass show beautifully the long roots protected at the tip by a root cap.

In growing in a glass, be careful to keep the water pure. Cloudy water means bacteria, and these will cause decay of the roots. Even when in the dark the glasses should be examined weekly, and the water changed when necessary. Keep a piece of charcoal in the water.

The same method should be pursued with at least one of the edible roots.

LITERATURE

Stories:

Kind Old Oak, Marah Pratt's Little Flower Folk.

Baby Bud's Winter Clothes, Emilie Poulsson's In the Child's World.

The Anxious Leaf, Beecher's Norwood.

Easy Poems:

Do the Little Brown Twigs Complain? } Eleanor Smith's Songs for Little Children.
Come Little Leaves. }

I'll Tell You How the Leaves Come Down, Susan Coolidge.

Kitten and the Falling Leaves, Wordsworth.

Some of the more difficult poems have already been given under the heading of Autumn at the beginning of the chapter.

ANIMALS

THE PIGEON.

Facts:

As its bill indicates, the pigeon is a grain-eating bird. It belongs to the Scratchers and not to the Perchers. This is shown by its feet, the toes of which, particularly the hind toe, are much stouter and shorter than those of the sparrow.

The nostrils are situated about the middle of the bill and can be located by the swollen skin above them. They drink without raising the head.

These birds build the roughest of nests, lay two white eggs, on which both the father and mother sit. The ugly naked young are called squabs. They are fed with a milklike secretion from the crop of their parents. Both squabs and pigeons are excellent food for men.

Method:

The same method of teaching should be used as in the study of the sparrow, which see, pp. 82, 83.

In addition, the children should compare the two birds and have a clear picture in their minds of Perchers and Scratchers.

ANIMAL PREPARATION FOR WINTER.

Facts:

The preparation made by the caterpillars for winter has been already demonstrated. They have either cov-

ered themselves with a thick coat and buried themselves beneath the ground, or else have spun for themselves a silken covering impervious either to moisture or to cold.

The locusts and most of the butterflies are dead. The Milkweed Butterfly, however, has gone south with many of the birds, and the Mourning Cloak, following the example of the Queen Humble Bee, has found some sheltered corner in which to spend the winter. Beetles are pupating in the ground. The larger animals, such as squirrels, snakes, tortoises, turtles, and the like, have found their winter quarters and have prepared for their long sleep, either by collecting a store on which to feed in the warmer days, or by having eaten a goodly supply when food was more abundant. Even the aquarium animals are more torpid and less inclined to eat.

Method:

Suggestions have already been given about the study of the various insects and how they may be kept in a schoolroom. It is equally easy to have squirrels, guinea pigs, rabbits, mice, garter snakes, turtles, and an aquarium. Cages with revolving wheels are manufactured specially for squirrels, giving the animal opportunity for plenty of exercise. Excellent cheap cages may be made with coarse meshed wire nailed over and above four upright supports. These need not be more than a foot and a half high for rabbits and guinea pigs. Three feet is a better height for squirrels.

Of course in the warm schoolroom they do not hibernate, but they do take much longer naps than in September. Make the children realize this fact and its reason. Observe, too, that the squirrel hides his nuts be-

fore eating them, the hereditary instinct to prepare for winter ruling him, even when no necessity for it exists.

Garter snakes, easily kept in insect vivaria of any kind, absolutely refuse to eat during the winter. The same is true of alligators and frogs.

Turtles will bury themselves in a bed of damp sand, allowing only the tip of the nose above ground.

Frogs may be kept similarly, although an aquarium with a large island, some water plants, and a very little water is more to their liking. It will be necessary to close the opening with netting.

Call attention to such facts with regard to hibernation and migration as happen to come within your horizon and that of the children. Supplement these with reading and language lessons.

LITERATURE

Stories :

The readers, particularly Johonnot's, are full of stories of pigeons, and also of the preparation of animals for winter.

The Stork (Migration of Birds), Andersen.
The Ant and the Grasshopper (Preparation of Animals for Winter), Æsop.
Hibernation of Bears, Readings in Nature's Book.
Coming and Going (Migration of Birds), Wiltse's Kindergarten Stories.
Broken Wing (Migration of Birds), Emerson's Indian Myths.
Crane Express, Emilie Poulsson's In the Child's World.

Poems :

Little Squirrel, St. Nicholas Songs.
Flight of the Birds, E. C. Stedman.
Departure of the Swallow, William Howitt.

CHAPTER IV

DECEMBER

Poems :

December, Longfellow.
December, Lowell.
In Time's Swing, Lucy Larcom.

WINTER.

Stories :

Ceres and Proserpine.
Death of Baldur.

Poems :

Winter, Tennyson.
Approach of Winter, B. W. Procter.
Woods in Winter, Longfellow.
Winter, Whittier's Child Life.

CHRISTMAS.

Stories :

Tiny Tim, Christmas Carol, Dickens.
The Fir Tree, } Andersen.
Last Dream of the Old Oak, } Andersen.
Story of Christmas, Mrs. Wiggin's and Miss Smith's The Story Hour.
Christmas, Irving's Sketch Book.

Easy Poems :

The Night Before Christmas, Whittier's Child Life.

Waken, Little Children, Christmas Hymn, Green Holly Boughs, Bells are Ringing,	Eleanor Smith's Songs for Little Children.

STARS.

First and Second Years.

Facts :

The stars which shine with a steady light are planets, like our own earth; those that twinkle, are suns. The brightest of the planets are Venus, sometimes visible in full daylight, and Jupiter, the largest of all. Venus is never seen except in the east or west; Jupiter is found in the south. Saturn is paler, and Mars may be known by its reddish color. The other planets are less easily found.

The twinkling of the fixed stars is not intrinsic, but due to atmospheric conditions. It is more marked in tropical regions, where, too, the stars are more brilliantly colored. In our own zone it is more noticeable just above the horizon than in the zenith.

The constellations most easily found in our latitude are the Great Bear, or Dipper, Cassiopeia, and the Dragon. When in addition to these Auriga and Lyra are known, all of the other constellations may be easily located.

The first brilliant star in a line with the two pointers of the Dipper is the North Star. This is again the outermost star of the handle of the Little Dipper. Directly opposite the Dipper, using the North Star as a centre, will be found the straggling W which makes the constellation of Cassiopeia. Equidistant from the North Star, and also from Cassiopeia and the Dipper, will be

found on the one side Capella, the most brilliant star of Auriga, and opposite to it, Vega, which belongs to Lyra.

The principal stars of Auriga form an irregular five-sided figure. Besides Vega, there is a parallelogram of four stars, forming the constellation of Lyra.

When once these constellations are learned, then with almost any of the numerous Guides to the Heavens, one may locate the others. This is not only a very enjoyable occupation, but will certainly, as nothing else can, put the teacher in touch with such of the myths as have a nature basis.

The Milky Way is a luminous, cloudlike band, which stretches across the heavens in a great circle, consisting of myriads of stars densely crowded together, but so far distant from us, that to our naked eyes there is only the appearance of diffused light.

Our earth is travelling forward rapidly through space with the sun, and, in addition to this, the stars themselves are moving in different directions and with varying velocity, so that ultimately the whole appearance of the heavens must change. Nevertheless, no variation worth mentioning, except by the astronomer, has yet occurred within the memory of man. Nothing is more invariable, apparently, than the stars. For this reason they are invaluable aids to the mariner.

Method:

Which gives us the most light, the sun or the moon? the moon or the stars? Why is the sun brighter than the moon? Why is the moon brighter than the stars? Which looks to be larger, the moon or the stars? Why? Some stars are like our earth; others like our sun. What does the earth look like to the people of Mars? If there are other inhabited worlds revolving round the star-suns, what does the earth look like to them? What does our sun look like?

Are the stars of any use to us?

LITERATURE

Myths:

The Great and Little Bear, — Diana, Callisto, and Arcas.
Draco, — Cadmus and Thebe.
Cassiopeia, — Perseus and Andromeda.
Aries, the Ram, — Story of the Golden Fleece.
The Pleiades.
Gemini, the Twins, — Castor and Pollux.
Orion.
Ariadne's Crown.
The Milky Way, a Russian Legend.
Indian Myths, { Star and the Lily. / Daughter of the Stars.

Stories:

Child's Dream of a Star, Dickens.
Will O' the Wisp, Mrs. Gatty's Parables from Nature.
Star of Bethlehem.

Easy Poems:

Stars and Daisies,
Sleep, Baby, Sleep,
Twinkle, Twinkle, Little Star, } Eleanor Smith's Songs for Little Children.
A Naughty Little Comet, Ella Wheeler Wilcox,
The Star's Ball, } Lovejoy's Nature in Verse.
Starlight, Lucy Larcom.
Daises,
Elfin Lamps, } F. D. Sherman, in Little Folks' Lyrics.
Stars, Barry Cornwall.
Legend of the Great Dipper,
Peep, Star, } Wiltse's Stories for Kindergartens.

WEATHER RECORD, No. III.

NOTE. — This should be printed on paper 8 in. × 12 in. to give sufficient space for children's writing.

Name, --

------------------*Grade.*

-- *School.*

Weather Record for the Month of ------------------------------------

Observations made at ----------------------------

Date	Direction of Wind	Force of Wind	Temperature	Rain or Snow	Clouds	Summary of Observations

WEATHER

SNOWFLAKES:

Take advantage of the first snowstorm for a lesson on the snowflakes.

Facts:

The relation between raindrops and snowflakes is very close. For example, the rains of winter are often due to the fact that the snow melts before reaching the earth, so that from the same clouds may fall snow on the highlands and rain in the valleys.

Snowflakes have always six parts. This is because the ice needles, acting like small magnets, are attracted and repelled by laws of their own, forming regular and very beautiful figures on the hexagonal plan.

Method:

Choose a snowstorm when the flakes are very large. Let the children collect the falling snowflakes on black cloth and observe their shape. What is happening to the snowflakes? Why? Who could turn the water drops back into snow? Where must the drops be to become snow crystals again? What does Jack Frost make of the water that is on the earth? in the sky?

What good is the snow to the plants? Who build houses of snow or ice to keep themselves warm?

WEATHER RECORDS:

The daily record for November (Weather Record, No. II.) must be examined by the children to determine the prevailing wind, its character, and the prevailing cloud forms of the months.

Weather Record, No. III. (p. 107), may be given to the children for December. The general plan outlines, in Chaps. II. and III. for using these, should be pursued.

LITERATURE

Stories:

Snow Queen, Snow Man, Ice Maiden, } Andersen.
Snow Image, Hawthorne.
Circle of Blessing, Mrs. Gatty's Parables from Nature.
Snow Flakes, Emilie Poulsson's In the Child's World.

Easy Poems:

The Tree in Winter, Snow Clouds, Little White Feather, Old Jack Frost, } Eleanor Smith's Songs for Little Children.
Tiny Little Snow Flakes, Walker's Songs and Games.
Snow Flakes, Mrs. Dodge's When Life is Young.
Snow Flakes (First Verse), Longfellow.
Hide and Seek, F. D. Sherman in Lovejoy's Nature in Verse.
Jack Frost, H. F. Gould, in Whittier's Child Life.
Snow Song, Lucy Larcom.

More Difficult Poems:

Winter, Tennyson.
Extract from Song of the Sower, Bryant.
Extract from Frost Spirit, Whittier.
Snow Storm, Emerson.
First Snow-fall, Lowell.
Snow Shower, Bryant.

PLANTS

The Holly, the Mistletoe, and the Christmas Tree, which is always either a Spruce or a Balsam Fir, should be saved for the lessons just before Christmas. The Christmas Tree might be studied by the pupils of the first and

second years, the Holly by the third year, and the Mistletoe by the fourth year.

The other common evergreens — Hemlock, Pine, Arbor Vitæ — may be studied earlier in the month.

PINES:

The pines most likely to be found in this vicinity are the White, Red, and Pitch Pine.

The WHITE PINE grows to be the tallest and most stately of all our American trees. Its bark is rather smooth and reddish green. Its branches are in whorls of five, and although all but the upper branches decay and disappear, yet traces remain of the older branches, and the age of the tree may be determined with their aid, since a new whorl is formed each year.


White Pine, branch and cone.

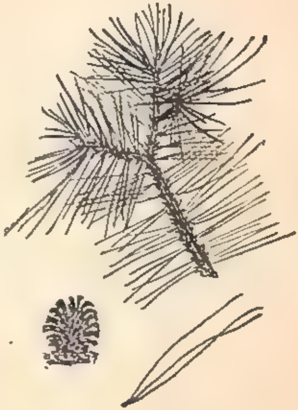
The long green leaves are five in number, and arranged in tufts at the ends of branches.

The year-old cones, two or three inches in length, are green. They are mature at the end of the next season, brown in color, and from four to six inches long. Before fertilization, the scales are open, so that the pollen may reach the ovules. Afterwards, they become tightly closed and open only to distribute the winged seeds, which, like nearly all the seeds of this family, are very excellent eating.

Pine wood is soft, but is much used for building and makes the best of masts.

Pitch Pine:

This tree may be distinguished from the above by its leaves, which grow in threes, by its irregular growth, and by its very rough bark. Its wood is much harder than the white pine, and therefore better for floors. Its branches, the pine knots of commerce, are full of resin. Like the scrub pine of New Jersey, it will grow in barren, sandy soil, where nothing else can flourish. The scrub pine has its green leaves in twos.



Pitch Pine, branch and cone.

Red or Norway Pine, branch and cone.

The Red Pine:

Its green leaves are in twos. Its bark is not nearly so rough as that of the pitch pine, and is in rather broad scales of reddish color.

The most valuable pine of all is the long-leaved southern pine, young trees

of which are brought into our markets about Christmas time. Its green leaves are in groups of three, and are used for the manufacture of "pine wool," from which cord and cloth are made. Its wood is extremely beautiful, hard, and of a lovely yellow color. From it are also obtained turpentine, tar, resin, and oil.

Method:

If possible, take the children where they can see pine trees growing. If this cannot be done, a picture of the tree and some branches may be made to answer the purpose.

What is the shape of the tree? Why? How are the branches arranged? If there is a circle of branches for each year, how old is this tree? What has become of the lower branches? Why have they disappeared rather than the upper ones?


Hemlock, branch and cone.

What is the color of the bark? What do you find underneath the bark? What does it smell like? Why?

How are its leaves different from other leaves that you have studied? What advantage is that? What is the shape of each leaf? Why? Do the leaves never fall? How do you know? What do the cones contain? Why are they now closed? When will they open? Why? What does the seed look like? Of what use is the wing?

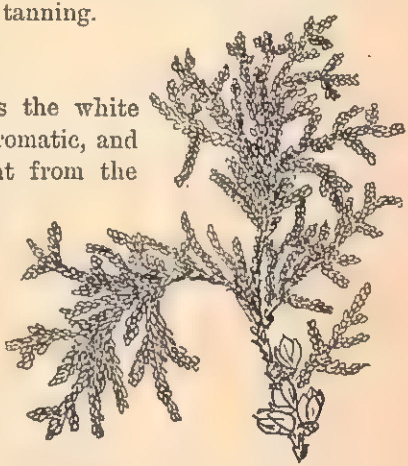
What use is the tree to us? How is turpentine made? pitch? tar?

HEMLOCK:

This is the most graceful of the evergreens, because of its drooping, feathery boughs. Its leaves are flat, dark, lustrous green above, white underneath, and arranged on both sides of the branch, which, in consequence, has a flat appearance. For this reason they make good brooms, and have often been used for this purpose by New England housewives. It attains its greatest beauty in the spring, when it is covered with tassels of pale green leaves. Its cones are small. Its bark, mixed with that of the oak, is used for tanning.

ARBOR VITÆ:

This tree resembles the white cedar. Its wood is aromatic, and its leaves are different from the evergreens above mentioned in that they are flat and scale-like.



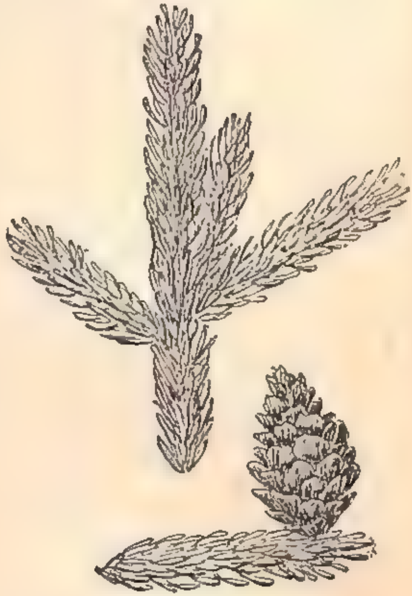
Arbor Vitæ, branch and cone.

BALSAM FIR:

This tree is the most commonly used for Christmas. It can easily be distinguished from the spruce by the blunt ends of its leaves, and by the fact that they are arranged only on the two opposite sides of the branch, making it flat instead of cylindrical, as is the case with the spruce. It is very aromatic. From its leaves are made balsam pillows. The tree has, until it grows old, a smooth bark. It is regular in shape. It has a whorl of five branches for each year's growth. Numerous large

cones add to its beauty. Its balsam (Canada balsam) is of commercial importance, but its wood has no value.

Balsam Fir, branch and cone.



Red Spruce, branch and cone.

SPRUCE:

The peculiarities of this tree are sufficiently indicated in the above account, and in the cut.

Its wood makes valuable lumber. Spruce gum found on the bark, and spruce beer made from the roots, are seldom seen outside of New England.

HOLLY:

Although the leaf of our American holly has not the gloss of its English cousin, nor are its berries quite so plentiful, yet it is a very beautiful substitute.

Its white flowers come in May. Its brilliant red berries doubtless serve to attract animals and lead them to distribute its seed, while its thorny leaves must certainly protect the little tree from unwelcome visitors. Its use at Christmas is doubtless due to its beauty and the evergreen character of its leaves. It has been said, however, to keep off witches by reason of its *holiness*, a quality to which its name is popularly supposed to be due.

MISTLETOE:

Like the holly, the English mistletoe is much more beautiful than its American cousin. Both mistletoes are partial parasites, taking from the wood of the host crude sap. This is made into elaborated food in the green leaves of the plant. Each of the numerous white pulpy berries contains a single seed, which, perhaps, is distributed by birds in their excreta, or rubbed off against the tree by the bill of birds, who care only for the flesh of the fruit. The use of the mistletoe at Christmas is doubtless due to the high esteem in which it was held by the Druids, whose priests, dressed in white, cut it from the oak or apple with a golden sickle, and distributed it to the people with great ceremony. Once thus obtained, it was supposed to be a heal-all and a charm against disaster.

It has been suggested that the frequent occurrence of its berries, in groups of three, — a sacred number, — may have had something to do with the high regard in which it was held. More likely this was due rather to its peculiar method of growth and the appearance of life which it gave to the apparently dead trees of winter.

Methods:

Sufficient suggestions were given under the Pine.

LITERATURE

Myths and Stories:

Death of Baldur (Mistletoe).
Law of the Wood (Spruce), Parables from Nature, Mrs. Gatty.
The Fir Tree, Andersen.
The Last Dream of the Old Oak, Andersen.
The Discontented Pine Tree, Marah Pratt's Fairy Land of Flowers

Easy Poems:

Christmas Eve, Mrs. Dodge's When Life is Young.
Hemlock Tree (first verse), Longfellow.

More Difficult Poems:

Pine Needles,
Little Pine Tree,
Holly,
Three Trees,
} Lovejoy's Nature in Verse.
Under the Holly Boughs, Eric Mackay.
Hiawatha's Sailing, Longfellow.

ANIMALS

THE AQUARIUM:

An aquarium properly cared for and intelligently used is not only an object of beauty in the schoolroom, but also an efficient aid in nature work. Unfortunately uncared for and unused aquaria are the rule; but this is not because there is any real difficulty in so establishing the proper balance between the plant and animal life that the tank is self-regulating. On the contrary, it is a perfectly simple thing to have a healthy, beautiful aquarium, which needs no care from year's end to year's end, except to feed the fish and occasionally to replenish the evaporated water.

These are the essentials:

1. A glass globe or jar.
2. River sand.
3. Water plants.
4. Cold water.
5. Light.
6. Animals.

1. The size or the shape of the aquarium is a matter of taste. The oblongs are more beautiful, perhaps, but they are also much more expensive, a medium size costing from two to three dollars. A cylindrical vessel holding five gallons, worth about a dollar and a quarter, would be an excellent choice.

2. The sand must be thoroughly cleaned by repeated washings. There should be two inches of sand covering the bottom of a five-gallon tank, for which also two bunches of Cabomba or Myriophyllum will be sufficient plants.

3. The lead should be removed from the plants, and the leaves broken from the stem for an inch from the base. Plant securely in the sand, preferably in the two rear corners.

4. Cold, clear water should be poured into the aquarium. Neither plants nor sand will be disturbed if the force of the falling water is broken by letting it fall first over the hand.

5. The aquarium should be permanently placed where it gets, if possible, good northern light. In a few days the water will be crystal clear, thoroughly aerated, ready for the animals.

6. Healthy American gold and silver fish cost a little more, but they are much hardier than the German fish,

which are so abundant at ten cents each, and so seldom worth buying. The latter are very apt to be consumptive, and, indeed, are frequently sold when in the last stages of consumption. A dorsal hump back of the head, ventral flatness, and rather frayed-out fins are sure indications of the disease.

The fish should not be too large nor too numerous. If you are so fortunate as to have a good northern exposure, and if the room is not overheated, a dozen medium-sized fish will not be too many in a five-gallon aquarium.

Young minnows, dace, black-banded sunfish, may be safely placed with gold fish, as well as tadpoles, snails, and mussels. Eels, sunnies, catfish, mud minnows, crayfish, beetles, must be cared for separately.

It is better to keep a few gold fish first, experimenting later with the less hardy but more interesting kinds. Snails, tadpoles, and mussels, however, do not complicate the feeding, and do add variety.

There are two kinds of pond snails, — those which breathe by means of lungs, Limnea (large), Physa (small), and those which breathe by gills, Paludina (large). The large species cost sometimes five cents each, while for the same sum a dozen of the smaller ones may be purchased. For teaching purposes, Limnea is particularly valuable, but it cuts up the plants.

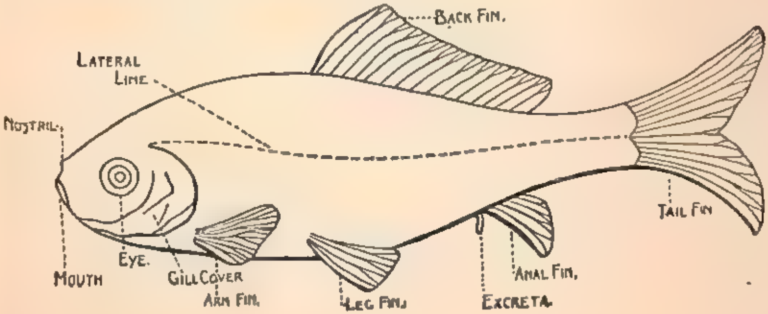
Mussels and tadpoles are cheap. Tadpoles bought now are not likely to develop much more until spring. Feeding them on raw-scraped beef, and keeping them in a warm room, often hastens the process.

Feed every other day. A piece of the prepared fish food two inches square ought to be sufficient for a dozen medium-sized gold fish. Snails, mussels, and tadpoles do not require special feeding. It is a good plan to give all

the animals once a week a very little scraped beef, but great care must be exercised to remove the undevoured food.

With a sponge, keep the outside and inside of the aquarium clean. The water in evaporating is apt to leave an ugly white line, which, however, may easily be removed. The water should be replenished from time to time, pouring it over the hand, as before, to break the force of its descent.

If the animals die, it is because they were diseased in the first place, or because the aquarium gets too little light, or because food is allowed to decay, or because the room is kept too hot for either fish or children. If the water becomes quickly green, it is because the aquarium receives too much light.



Fish.

Facts:

The external anatomy of the fish is probably sufficiently indicated by the cut. The arm and leg fins, so named from their homology to our own legs and arms, are paired. All of the other fins are single. In some of the lower fish and in some embryos, the back, tail, and anal fins are

united in one. The arm and leg fins do the swimming, while the steering is done by the muscular tail and the tail fin.

To understand clearly the breathing of fish, it is necessary for the teacher to understand the breathing of plants. This function is properly called respiration in plants as well as in animals, because in both the outward visible sign is the same, viz., the giving off of carbon dioxide. Respiration in the case of plants is continually taking place, but under certain conditions more than enough oxygen is given off to mask completely the breathing. These conditions are the assimilation of the food which is brought about by the presence of some carbon dioxide and strong light. The carbon dioxide is breathed out by both fish and plants.

Now it follows that an aquarium with plants, light, and animals can be made self-supporting, since in the light the plants yield what the fish must have in abundance for their respiration, while the fish give in return the carbon dioxide necessary to the assimilation of the plants. In breathing, the fish swallows the water oxygenated by the plants. As it is washed past its four pairs of red gills, an osmosis of the two gases — the carbon dioxide of the blood and the free oxygen in the water — takes place. The blood is thus purified, and the water charged with carbon dioxide passes out under the gill covers, carrying to the plant what it needs for its food, and receiving from it again the oxygen necessary to all the animals in the aquarium.

The nostrils of the gold fish are well developed and easily seen. In them is located the sense of smell. They take no part in the work of breathing.

The eyes are movable, but unprotected by lids.

In the lateral line are located sense organs, whose exact function is not as yet satisfactorily determined. The appearance is due to the perforation of the scales in that region.

The whole body of the fish is covered with a skin, underneath which are the numerous protecting scales, all of which point backward — one of the many adaptations of the parts of the fish to forward movement.

The viscera are all situated in a body cavity in the lower forward part of the body. All the rest of the fish (except, of course, the head) is made up of bone and muscle.

Many fish are so transparent that it is quite easy to make out the much-coiled intestine, and above it the silvery air bladder, which helps to keep it afloat.

Method:

Lead the children to observe the breathing, eating, and motion of the fish by watching and feeding the animals before and after school.

Give each child a piece of paper and tell her to write a sentence, telling the number of fins which the gold fish has.

Invariably they say five.

Give to each a hektograph drawing telling them that they may reconsider their answer.

Send to the aquarium those who do not yet see that with the two pairs of paired fins there are altogether seven fins.

Teach them the names of the fins.

Give them, a few at a time, such questions as these to be answered by observation: Of what use is the tail to the fish? Which fins are most used in swimming?

Why does the fish open his mouth continually when he is not eating? What else opens as frequently? Why?

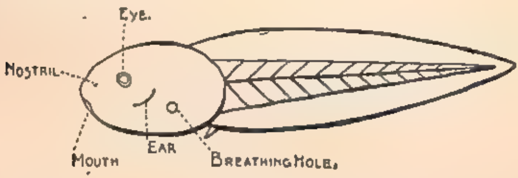
With the drawings, teach nostrils, mouth, gill covers, scales, lateral line, straightening out at the same time their ideas of the functions of these organs.

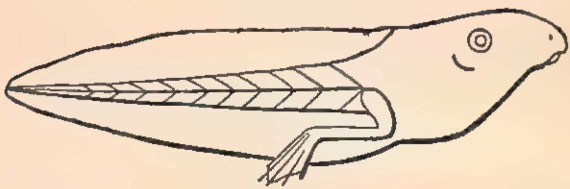
Teach the elimination of the waste food, which is very evident in the gold fish.

Tadpole.

Facts:

The tadpole is the larval form of a frog or toad, re-





sembling its fishlike ancestor much more than its prospective adult form.

Like the fish, it breathes by means of gills and lives in the water, but it has no fins and only one breathing hole, which is on the left side of the body.

From the gelatinous spawn of the frog is hatched out a tiny fishlike creature with rudiments of gills and with two disks on the head by which it clings to plants. Then the three pairs of external gills develop. At their roots are narrow clefts, which lead into the throat, out of which comes the water taken in by the mouth. A fold of the skin grows over the gills, leaving only a small opening on the left side, through which they protrude for a time. They soon atrophy, however, and are succeeded by internal gills. In the meantime, the eyes, the nose (two nostrils in front of the eyes), the ears (circular patches back of the eyes), become distinct. The tadpole eats with a lip beset with numerous horny papillæ surrounding the mouth. The intestine is very long and coiled like a watch spring.

The hind legs are first visible. With the growth of the legs, the tail shortens, the mouth elongates, the lip disappears, teeth develop in the upper jaw and on the roof of the mouth, and the animal gives up its mixed diet, preferring chiefly insects.

The adult frog breathes by means of his skin, as well as by his lungs. It is necessary for his lung respiration that his mouth should be closed. The air is drawn in through the nostrils, which then close, while the under side of the throat is swollen, then flattened out, as the air is expelled.

There is a pair of lymph hearts, which may be observed to pulsate near the end and on either side of the back bone.

The fore legs are much shorter than the hind legs.

They each have four toes, which correspond to our four fingers. The hind legs are five toed and webbed.

The male has a vocal sac, by means of which, particularly in the spring, he gives his love croak. The tongue in both sexes is two forked, and attached to the middle part of the jaw by its forward end.

The eggs of a toad occur in strings. The toad tadpole is black, much smaller, and develops more quickly into the adult form than the tadpole of the frog.

Method:

Is the tadpole a fish? Why?

So far as appearances go, there are good arguments, to the mind of the child, on both sides. The mental discipline involved in weighing the evidence and settling the question is very valuable, particularly when he is subsequently required to state sharply and clearly the resemblances and differences between the embryonic frog and the adult fish. If children have already witnessed the metamorphosis of the tadpole, review the facts with individual drawings. Otherwise, wait until spring, when this wonderful change is sure to occur in the schoolroom.

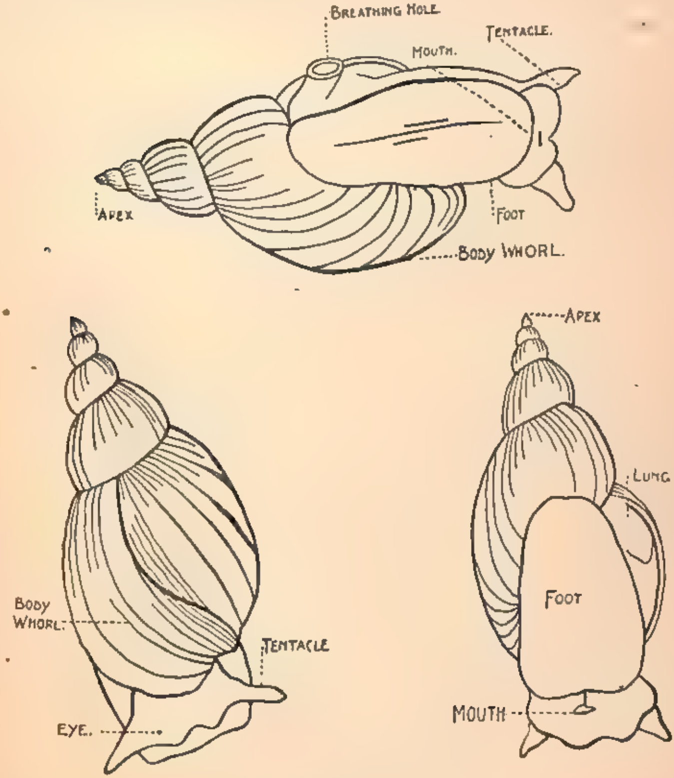
Snail.

Facts:

Observe in the living animal the brown skin with the limy shell underneath. The sutures, the whorls, the spire, the apex, the body whorl, the lines of growth, the mouth, the operculum, the foot, the eyes, the tentacles, the mantle, are all shown in the drawings.

Limnea is an example of a lung-breathing pond snail; and, like other lung breathers, keeps the surface of the water clean. The snail ascends at fairly regular inter-

vals, forces out a bubble of air, and takes in a fresh supply. Both sexes are united in the one animal, and the semi-transparent eggs, laid in gelatinous masses, are

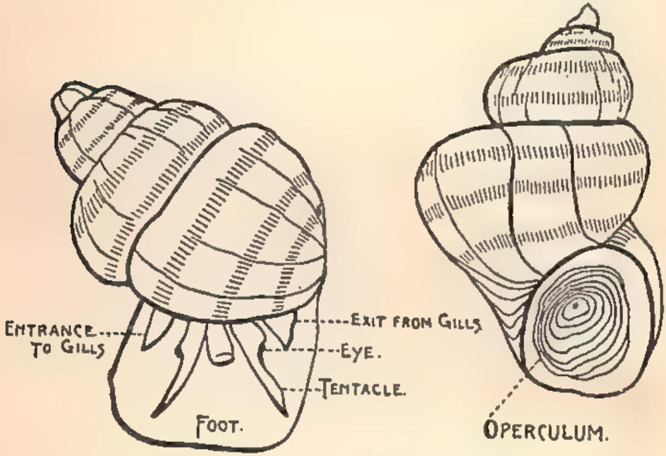


Limnea, a lung-breather.

to be found on the plants in the aquarium or along the sides. In dry or cold weather it protects itself by secreting a membrane which covers the opening.

Of the smaller air-breathing pond snails, Physa is a good example.

Paludina is a gill-breathing pond snail. The water is conveyed to the gills by a tube on the right, and is then forced out of the tube on the left. The proboscis is well developed. The eyes at the base of the tentacles are borne on small projections. The young are brought forth alive,



Paludina, a gill-breather.

the eggs developing inside of the mother. Only the gill-breathing forms have an operculum. "Eye stones" are small lime opercula. Land snails have two pairs of tentacles. On the longer of these are borne the eyes, which can be invaginated. Land snails are found wherever there is lime and moisture. They both breathe and protect themselves from cold and dryness, like Limnea. To this genus (Helix) belong the edible snails.

Slugs are nocturnal lung-breathers, who do much damage in gardens. The saddle is all that is left to represent the mantle. There is an opening on the right side which admits air. Underneath the mantle is usually a small horny disk.

Methods:

How do the snails reach the top of the water? How often does Limnea come to the top? Why?

What does the snail eat? How?

How does the snail move?

Distribute the empty shells. Let the children scrape off the brown skin and test with strong vinegar the shell beneath. The effervescence proves that it consists of lime carbonate.

What good to the shell is the brown skin? What has happened to the tip where the skin has worn off?

With hektograph or blackboard drawings, teach the parts of the animal. Land snails and slugs may be similarly treated, or may be omitted, or taught by letting the children read about them.

Mussels.

Facts:

The mussels of the aquarium are really fresh-water clams.

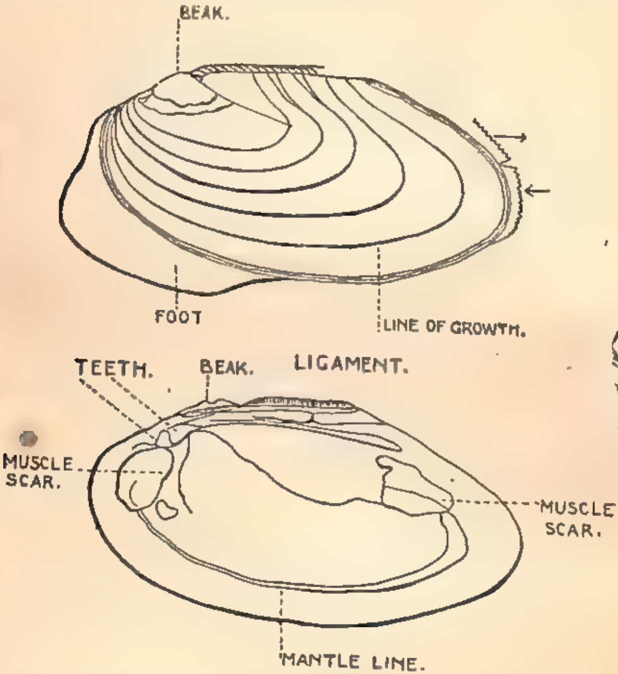
The parts of the animal are sufficiently indicated in the drawings on the next page.

To the crawling action of the foot are due the long tracks so often seen in the sand.

The pearly lining of the shell is very beautiful and one of the sources of domestic mother-of-pearl.

The young of the mussel are stored away in the gill

chamber for a time. Then they attach themselves to the fins of fish, and, after a semi-parasitic existence, drop to the sand small adult mussels.



Reading and language lessons on the oyster and clam will be particularly valuable after the lessons on the mussel.

LITERATURE

Neptune.

Hiawatha's Fishing.

Water Babies, Kingsley.

The Readers, particularly Johonnot's, are full of interesting accounts of fish, frogs, snails, and mussels.

CHAPTER V

JANUARY

New Year Myths and Stories:

Kronos.
Janus.
Story of the Year, Andersen.
Little Match Seller, Andersen.
A New Year's Bargain, Susan Coolidge.

Head of Janus.

Poems:

The Little New Year, Walker's Songs and Games.
January, Alice Cary.
A New Year's Greeting, Lowell.
A New Year, Mrs. Dodge's When Life is Young.
A Suggestion for a Happy New Year, } Mrs. Dodge's When Life is Young.
In Trust, }
New Year Song, Lucy Larcom.

WEATHER

In the examination of the weather record for December, the children will have a new problem. Instead of questions to be answered, there is now a column in which they are to make a general summary of their ob-

servations for the month. Before allowing them to write this, conduct an oral discussion on generalizations with which they are already familiar, such as the prevailing direction and force of the wind and cloud forms. After these facts have been determined and written up, teach them to summarize the temperature in the same way by determining the average temperature for the month, the temperature of the coldest and of the warmest day, which winds caused a fall in temperature, which a rise. This will necessitate in most instances teaching them what is meant by an average, and how it is found, much earlier than the course in arithmetic provides.

In the keeping of January's weather record, provision should be made for recording the rain or snow fall in inches. The standard rain gauge used by the United States government costs five dollars. It is a cylindrical can, so planned that the amount of the rainfall is multiplied by ten.

If this instrument is too expensive, the main purpose may be served by using a tin can with a sharp, even rim, and, in place of the graduated cedar stick which comes with the official gauge, an unvarnished stick, with the tenths of inches marked upon it.

Whatever the instrument, it should be placed in an open space, and the children should see why this is essential.

Snow is melted before measuring.

It is very difficult to get the whole snowfall. Perhaps as accurate a way as any is to cut out with the inverted can a circular section of the snow. Melt and measure this. Of course a place must be selected where the snow has not drifted.

The teacher should get for her own use the daily

weather map sent out by the government, and to be had on application to the Local Weather Bureau.

PHYSICS

Evaporation, Boiling, and Condensation.

Facts:

Under the influence of heat, water evaporates, that is to say, it passes into the air in the form of invisible vapor. The greater the heat, the greater the surface exposure; and the stronger the wind, the more rapid will be the evaporation.

In boiling, the first bubbles that are formed contain air. They break quietly. Soon, however, numerous small bubbles are formed at the bottom and middle of the dish which break explosively, increasing in size as they reach the surface of the water.

Immediately above the water, or close to the spout of a teakettle, no steam can be seen; but just as soon as this true steam comes in contact with the colder air outside, it is condensed into water dust and becomes visible. The temperature of the water and of the steam does not vary after boiling is well under way, although of course the fire underneath becomes hotter and hotter. This extra heat causes the water to break up more rapidly.

Whenever water vapor comes in contact with a colder solid, the water condenses on that solid.

Method:

Why do we add water to the aquarium? Where does the water go? Can we see it? From which would it disappear more quickly, a deep dish or a shallow one? How shall we find out?

Set up the experiment in accordance with their directions.

If the children do not know that the water passes into the air, write on the blackboard with a wet sponge, or wring out and hang up to dry a piece of cloth, etc., and let them watch the drying.

Do clothes dry more rapidly in winter or in summer? When the air is still or in a wind?

Why did the water evaporate more quickly in the shallow dish than in the deeper one? How can we find out certainly whether heat and wind hasten evaporation?

Set up the experiments in accordance with their directions. In these, as in all other experiments, the teacher must see that the children eliminate all unequal conditions. For example, the volumes of water in the two dishes must be equal; the remaining volumes must be exactly measured; when experimenting with temperature both dishes must be protected from currents of air, and *vice versa.*

By means of a spirit lamp, or a Bunsen burner, water may be made to boil in a kettle or dish with a spout in the presence of the seated children. Lead them to see that the steam is invisible near the spout, and that a flame held below the steam beyond makes it invisible again.

Tell them to boil some water in a shallow dish on the stove at home, and to bring you the answers to the following questions: What happens just before the water begins to boil? Where do the bubbles form? Where are they largest?

Send them all to the blackboard. Let them touch it with their fingers. Is it warmer or colder? Let them breathe on it. What has happened? Where did the

moisture come from? What happens to our breath on a cold day? Bring a pitcher of ice water into the room. What has happened? Let some one breathe on the cold window pane. What has happened? Hold a cold slate above boiling water. What happens to spectacles in going from the cold into a warm room?

Which is colder, your breath or the blackboard? Your breath or the cold air? The air of the room or the pitcher? Your breath or the window pane? The slate or the steam? The air of the room or the glass of the spectacles?

When only does the air give up its moisture? On what is this moisture deposited?

PLANTS:

If there was not sufficient time in December for the study of the commoner evergreens, continue their study in January. If possible, begin in this month the study of the germination of seeds.

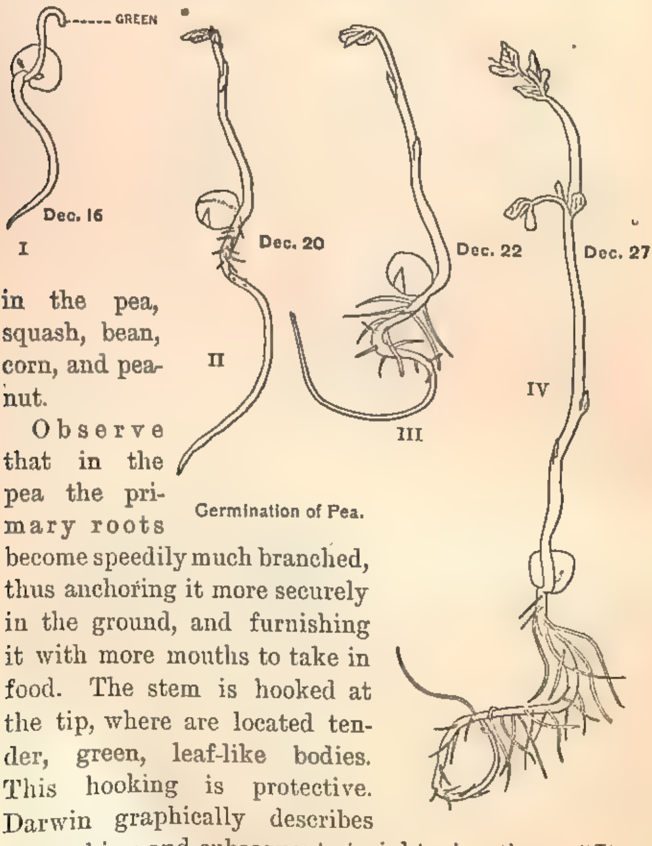
GERMINATION OF SEEDS:

Facts:

Usually seeds will not germinate until they are persuaded that winter has passed and gone and that spring has really come. To make them believe this they must be given plenty of moisture and warmth. Water softens the food stored round or in the baby plant by its provident mother, allows the ferment to act which changes it into food immediately available for growth, viz., sugar.

The first visible phenomenon of germination is the absorption of water and consequent swelling of the seed. Then the coat is broken by the radicle, which is pointed at the tip that it may more easily penetrate the ground.

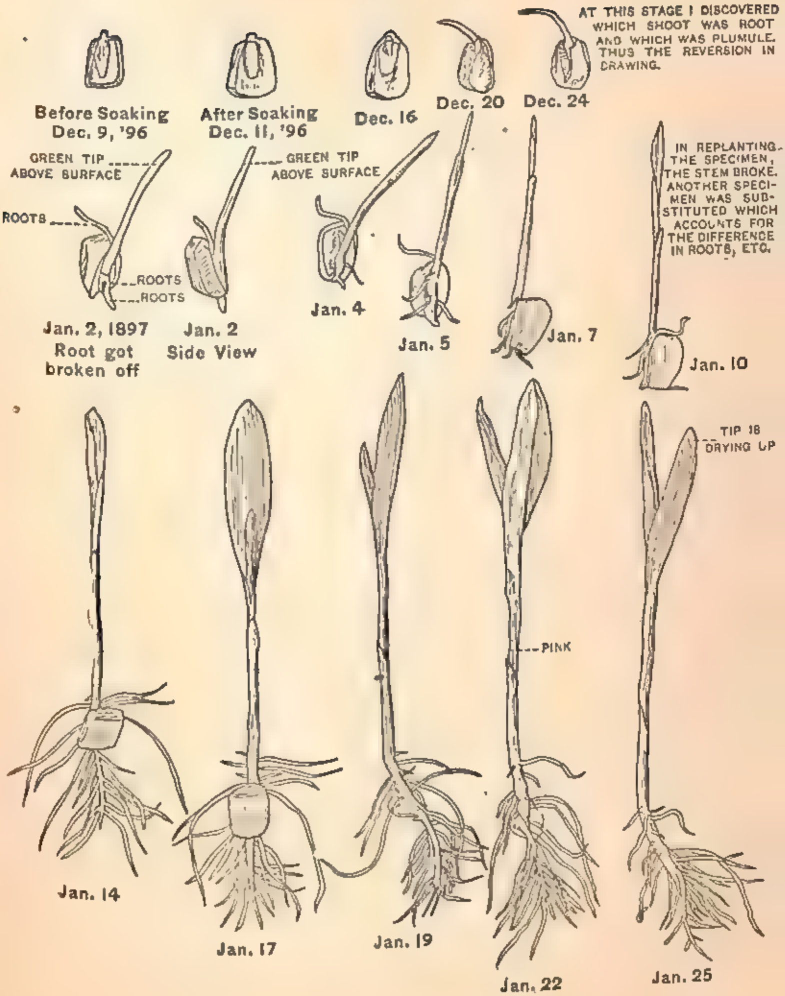
The subsequent phenomena vary with the seed used. The following drawings, made by a student of mine in the Normal School, show what any observant person may see



Germination of Pea.

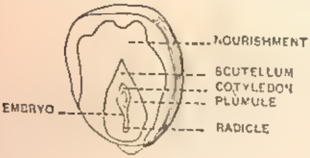
in the pea, squash, bean, corn, and peanut.

Observe that in the pea the primary roots become speedily much branched, thus anchoring it more securely in the ground, and furnishing it with more mouths to take in food. The stem is hooked at the tip, where are located tender, green, leaf-like bodies. This hooking is protective. Darwin graphically describes the arching and subsequent straightening thus: "It may be convenient to summarize, under the form of an illustration, the usual movements of seedlings whilst breaking



Germination of Corn Grain.

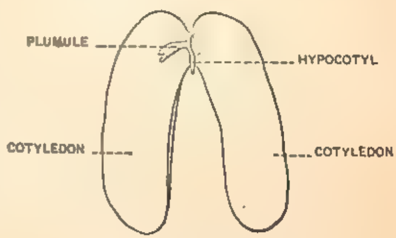
through the ground and immediately afterwards. We may suppose a man to be thrown down on his hands and knees, and at the same time to one side, by a load of hay falling on him. He would first endeavor to get his arched back upright, wriggling at the same time in all directions to free himself a little from the surrounding pressure. The man, still wriggling, would then raise his arched back as high as he could. As soon as he felt himself at all free, he would raise the upper part of his body, whilst still on his knees and still wriggling."



Grain of Corn dissected.

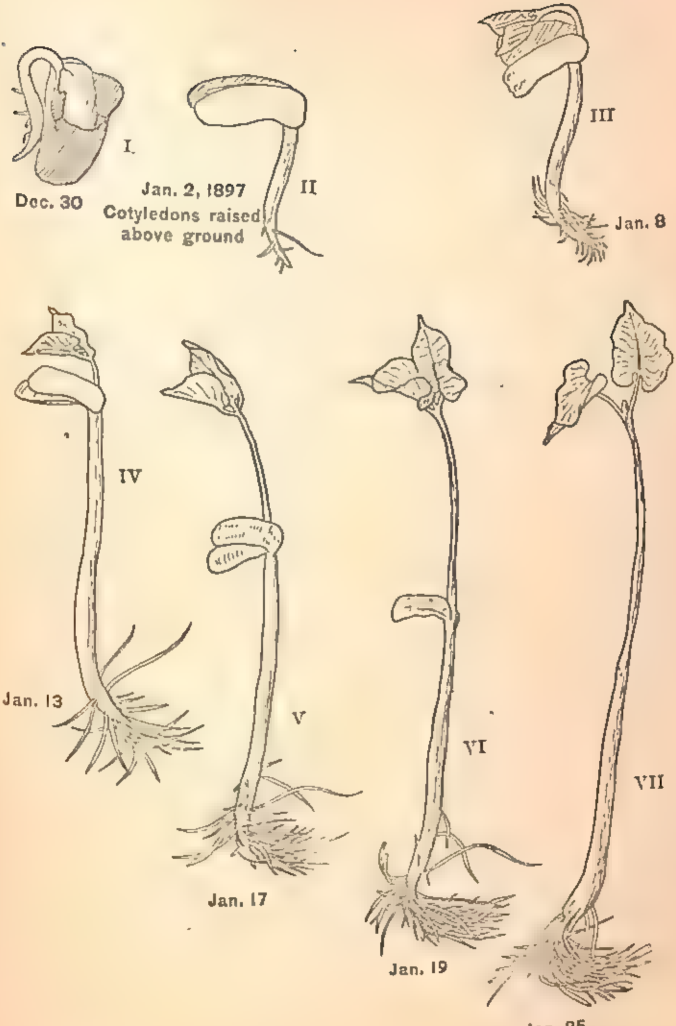
The corn differs from the pea in that its one cotyledon comes above ground instead of remaining buried underneath, like the two cotyledons of the pea. This cotyledon, or sheath, protects the bud within, until its stiff and sharp point has pierced the ground. For this reason the branch is not arched, as is the case in the pea.

Instead of having only a single branched primary root, it has also several secondary roots that remain unbranched for some time.



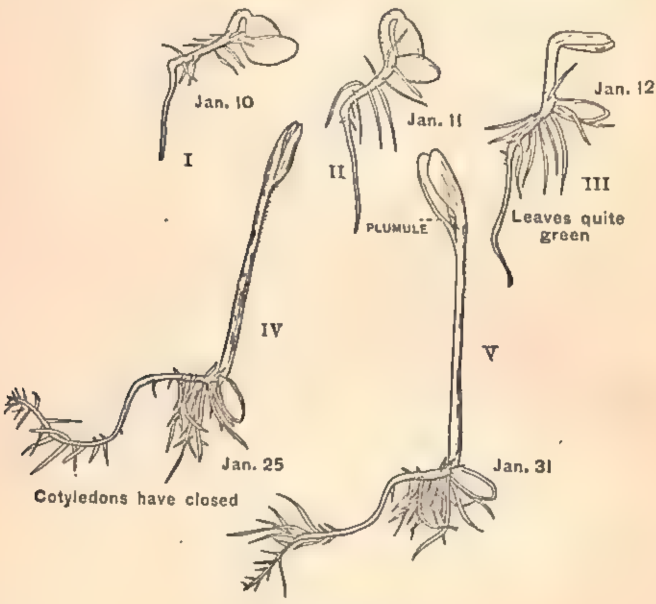
Bean, showing embryo.

The leaves of the wheat are parallel veined; those of the pea, netted veined. The former is the characteristic of almost all monocotyledonous plants; the latter is true of all the dicotyledonous.



Germination of a Bean.

The squash gets rid of its thick seed coats in a peculiar manner. On the root is formed a peg, which as it grows pushes open the coats, out of which come the two cotyledons, which as they reach the light become veined

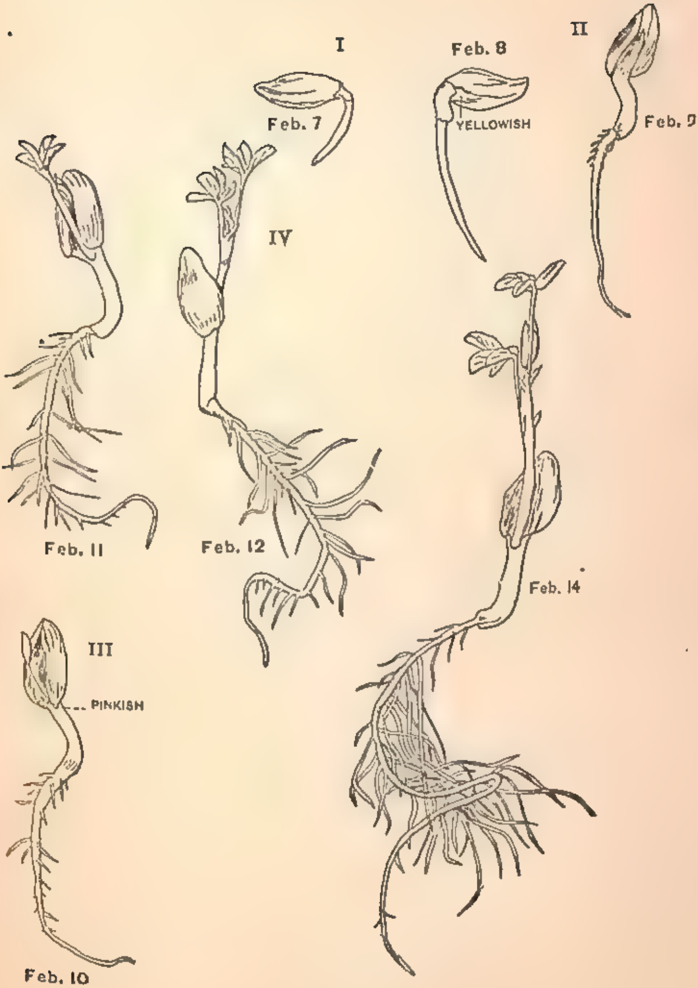


Germination of a Squash.

and green — seed leaves in appearance as well as in name.

The seed leaves (cotyledons) of the bean and peanut "sleep" at night, thus protecting the tender leaves within.

The facts with reference to the other seeds are sufficiently indicated by the drawings.



Germination of a Peanut.

Seeds need moisture, air, and warmth in order to germinate. Light is non-essential in the beginning, but is a necessity after the plants have come above the ground.

Method:

Seeds may be germinated in sand, in sawdust, on a damp sponge, in a tumbler, on raw cotton, or on blotting paper similarly placed. With young pupils, however, I have found the following to work admirably:

Each pupil is requested to bring one, or better two, tumblers and a piece of string, a foot long. They are then given each a small gummed label on which the name is written, and then attached to the tumblers.

Squares of coarse cheese cloth, or of mosquito netting, are given to each, and by each tied across the labelled tumbler. The tumbler should now be filled with water so that the centre of the cloth is wet. Here place the soaked seeds, and cover with another tumbler, if possible, to protect the seeds from the dry, hot air of the ordinary schoolroom.

It will be less trouble to show the children a tumbler properly prepared, and giving them each a label and mosquito netting, let them do the work at home.

Shall we place these tumblers in the light or in the dark? If there is a difference of opinion, allow those who think that the dark will be better to place their seeds there, and *vice versa*. If no one wishes to do this, extra sets may be prepared by the teacher and so placed.

Shall we place them in the cold, on the window ledge, or inside in the warmth? As before, arrange to have some seeds in the cold.

The best seeds for study, because they are sure to

germinate even under unfavorable circumstances, are peas and wheat. Squash ranks third, but the others before mentioned do better either in sand, sawdust, or earth.

For this reason I give the children soaked wheat and peas for their tumblers, letting them have the others for home growth.

Fill a small, thin, glass bottle with dry peas. Cover the mouth with stout muslin tightly tied with twine. Invert the bottle in a pail, placing the whole apparatus in full sight.

The seeds will absorb the moisture so rapidly, gaining so much in size, that the bottle will burst in from two to four hours.

It will not be necessary to question the children about the experiment, or to ask them to give their attention. Every move of yours will be watched. Instead of allowing them to tell you what has happened, let them write an account of what was done and its consequences.

Instead of this, dry peas and peas soaked in water over night may be distributed, one of each kind for every child.

Ask the following questions, not, however, allowing oral answers, but giving sufficient time between the questions for good silent thought and work: Are these peas of the same color? size? shape? hardness? With a pin, take off a portion of the coat of each. Hold this piece between the eye and the light. How many layers do you see? Are these layers of the same thickness?

Remove the entire coat of the soaked pea. What is left? Are these parts still connected?

Now give out paper, asking them to write all that they

have learned and to draw the remaining pea, showing as much as can be shown in one drawing. They might also draw the half of the pea which shows the embryo.

Still another method of introducing the subject of germination is to fill the skull of any animal with dried peas, closing the foramen with stout muslin, as indicated in the bottle experiment. The skull should be placed in a dish of water. In less than a day it will be beautifully disarticulated.

The teacher should grow, preferably in damp sawdust, a number of the seeds, planting a fresh lot every week, so that she may have on hand plenty of material for her own and the children's study.

Care must be taken that the seeds are not kept too wet. Under ordinary conditions it will not be necessary to change the water, but if it does become cloudy, let the children pour it out, rinse the tumbler and refill. This can be easily done without disturbing the seeds.

It will be about a week before the seeds have made any perceptible progress. From your own store of material, select seeds which are in about the same stage of growth, and give one to each child.

What has happened? How did it happen? What will this little root do? Why?

Bring the seeds from the dark and from the cold—the dry seeds. Which seeds have grown best? Why? Which have grown least? Why? How many would like to put their tumblers in the dark room? Why?

Older Seeds: What has happened to the root of the pea? Why? What difference is there between the

root of the pea and that of the wheat? What has happened to the stem of the pea? Look at the tip of this stem. What do you find there? Touch them. Why is this tip bent under? But the pea does not have to push its way through dirt or anything else in your tumbler, so why should it be arched here? How does the stem of the wheat differ from that of the pea? Why?

Still Older Seedlings: Why was the root of the pea branched? Why was the stem uncoiled? What similar changes have taken place in the wheat?

Still Older Seedlings: Compare the netted veined, compound stipulate leaves of the pea with the simple parallel-veined leaf of the wheat. Teach the term "seed leaf."

Give them all the stages of the pea to arrange in order and to draw. Require the labelling of the following parts, — root, branch, leaf, tendril, seed leaves.

Give them all the stages of the wheat to arrange and draw in the same way.

Teach them something of the Pea family, with its butterfly-like flowers, and its very useful seeds. Its best known members are the bean, clover, locust, and peanut.

To the Grass family belong not only the grass and wheat, but also corn and all the other grains.

LITERATURE

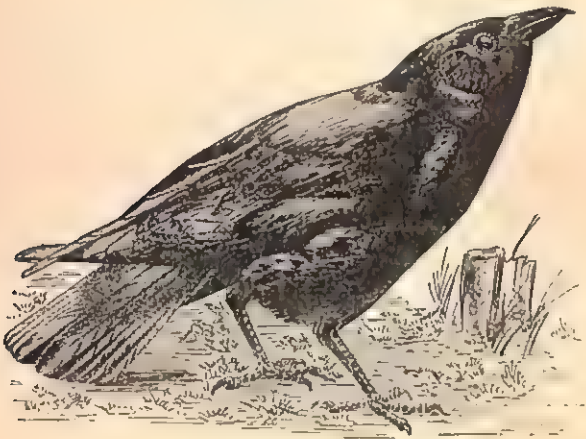
Stories:

Little Grain of Wheat, Mrs. Burnett. This is published in the Little St. Elizabeth volume.
Five Peas in a Pod, Andersen.
Unopened Parcels, Mrs. Gatty's Parables from Nature.

Story of the Seed, George MacDonald's, David Elginbrood.
Treasure Boxes, } Jane Andrews' Stories Mother Nature Told.
Quercus Alba, }
Picciola, Xavier Saintine.

ANIMALS

The Crow, Owl, and Woodpecker are, next to the sparrows and pigeons, the best known resident birds.



Crow.

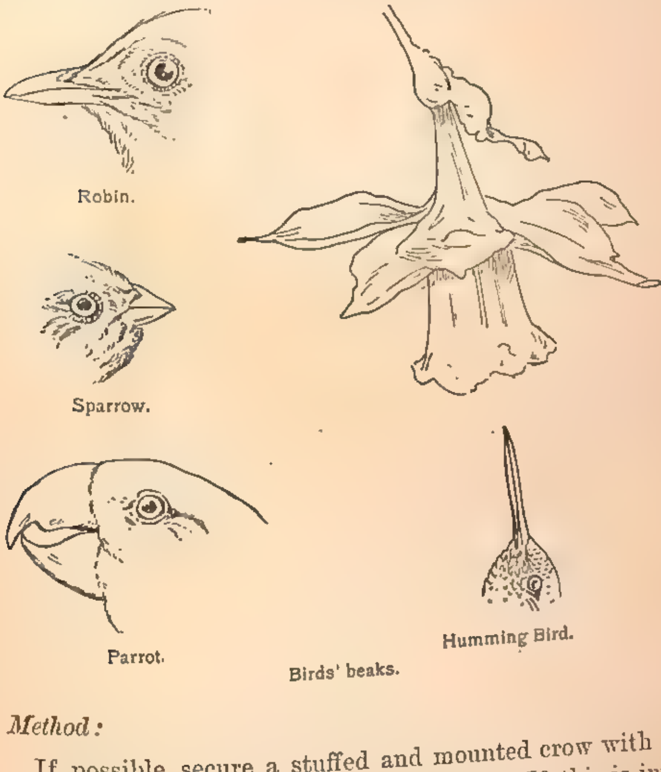
CROW.

Facts:

The crow belongs to the same family as the ravens, jays, jackdaws, magpies. It has stout perching feet also adapted for walking. Its beak is large, strong, and slightly hooked at the end. In flying, the wings appear saw-toothed.

Its nest is very large, resting on a platform of sticks, made up in great part of cedar bark, and containing from

four to seven large, strong, green eggs specked with brown. Its call note is "Caw." Its food is corn, young birds, birds' eggs, and sometimes stray insects and field mice.



Birds' beaks.

Method:

If possible, secure a stuffed and mounted crow with a nest filled with its proper quota of eggs. If this is impossible, give the children hektograph drawings.

What bird is this? When and where have you seen it? Look at its beak. How does it differ from the beak of the sparrow and pigeon? What do you think,

then, is its food? Of what use to it is the hook at the end?

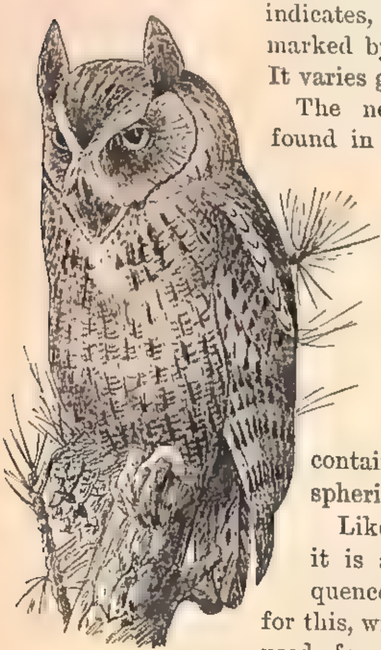
Look at its feet. How are they like the sparrow's foot? What can it do then? How are they different? Why?

Owl.

Facts:

The commonest of the resident Owls is the little horned or screech owl (*Megascops asio*). As its name indicates, the head of this species is marked by a horn or tuft of feathers. It varies greatly in color.

The nests are most frequently found in the hollows of trees, and



Horned Owl.

Beak of Falcon.

contain from four to six nearly spherical white eggs.

Like all the owls and hawks, it is a bird of prey. In consequence, its beak is sharply hooked, for this, with its stout, strong claws, is used for tearing its food. It eats mice, English sparrows, cut worms, and other animals. It is a nocturnal bird. Doubtless because of its downy plumage, it makes little noise in flying.

The barn owl, the cat owl, the barred owl (hoot owl), the great horned owl, are also residents, and the snowy owl, while breeding further north, is sometimes seen here in the winter.

Red-headed Woodpecker.

WOODPECKER.

Facts:

All of the woodpeckers are climbers, and have, in consequence, two of their toes in front and one or two behind.

The bill is a long, strong chisel, well adapted for boring into trees, which it does to make its nest. The tongue is long and remarkably extensile. By means of this, it catches the insects which hide themselves under the bark of trees.

They are mostly resident birds feeding, as they do, on dormant insects which are always abundant.

Methods:

These have been sufficiently indicated in the account of the Crow.

Woodpecker's bill and tongue.

If there is time, it would be well for the children of

the third and fourth years, since they have now studied perchers, scratchers, climbers, and birds of prey, to study the waders, the swimmers, and the runners.

Of the first, either the heron or stork is an example. Notice the beak adapted for the catching and devouring

Swimmer: Goose.

Wader: Green Heron.

Running: Ostrich.

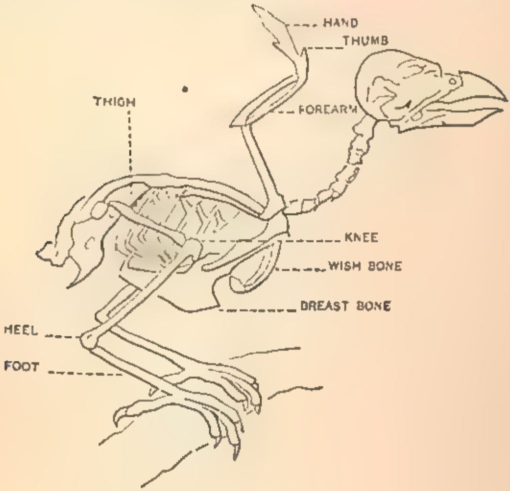
Climber: Wood-pecker.

Percher.

Scratcher: Grouse.

Bird of prey. Eagle.

of fish. Ducks are swimmers. Notice their broad beaks, with strainer-like teeth, the adaptation of their feet to the soft mud, the boat-shaped body, and the legs well placed for rowing. The ostrich, whose foot more nearly approaches the human foot, is a splendid runner.



Skeleton of Sparrow.

Bones of Birds.

Facts:

Most of the bones of adult birds are hollow and filled with air, whereas the bones of mammals are always heavy, and when not solid are filled with marrow.

This fact accounts in a great measure for the lightness of the body of birds, and the length of time which a diving bird can stay underneath the water.

In the skeleton of a bird, notice the deep, thin breast bone, and the "wish" or collar bone on which we find

the solid white meat — muscle to move the wings; the wing which corresponds to the arm even having a rudimentary thumb; the knee, bending in the same direction as our knee; the ankle joint, with the heel; the long leg-like foot; and the tail bone.

Method:

Get from the children meat and chicken bones enough, if possible, so that each child may have one of each for comparison.

The bones should be cleaned and broken, so as to show their structure.

Which are chicken bones? Why do you think so? What other differences between these bones? Have you never seen a hollow bone in beefsteak or other red meat? What filled the opening? Which bones are heavier? What advantage is it to the cow to have heavy bones? What disadvantage would they be to the birds?

Draw on the board the skeleton of a bird. Let the children pick out such bones as they know — the wish bone, wing, drumstick, breast bone, neck, back bone, ribs. Let them see the use of each, and its analogy and homology to the same bones in our own bodies.

Feathers of Birds.

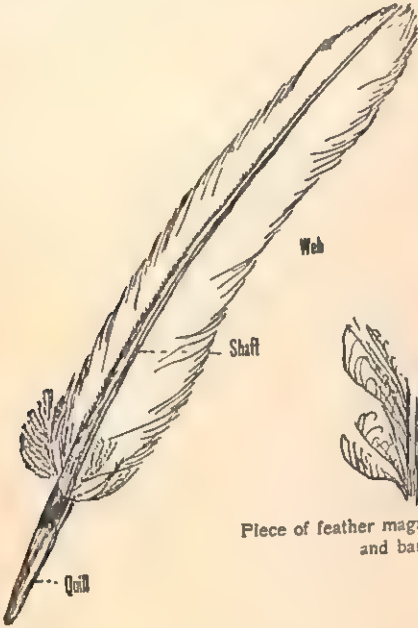
Facts:

The feathers of birds are outgrowths from the skin, differing from the scales of reptiles and the hair of the mammals in character but not in origin.

The parts of the feather are the quills, the shaft, the barbs, and the barbules. The quill is hollow. The shaft is filled with a light pith. The barbules are covered with fine threads, usually hooked at the tip, thus fasten-

ing together the barbs, and making of them a close web, which resists the air, thus making it possible for the bird to fly.

Besides the quill feathers from the wings and tail, there are the slighter clothing feathers, and in some birds, down.



Piece of feather magnified, showing barbs and barbules.

Method:

Secure from a provision dealer a supply of quill, clothing, and down feathers.

Put in envelopes one of each, and distribute to the children for comparison.

Tell the story of the eider duck, which again and again plucks first her own and then the breast of her mate to

reline the nest, from which men have stolen the soft down.

Ostrich feathers, the ostrich, and ostrich farming make interesting lessons.

LITERATURE

The Readers are full of accounts of all the birds here mentioned.
Why the Crow is Black, Chaucer's Canterbury Tales.
Legend of the Woodpecker, Cooke's Nature Myths.
A Legend of the Northland (The Woodpecker), Phœbe Cary.
The Crow's Children, Phœbe Cary.
The Owl, Tennyson.

CHAPTER VI

FEBRUARY

An Afternoon in February, Longfellow.

WEATHER

The lessons on evaporation, boiling, and condensation, which have now been taken by children in all the grades, should be reviewed in connection with the following lessons on cloud formation, rain, snow, hail, dew, and frost.

Facts:

The heat of the sun causes constant evaporation from the surface of all water exposed to its rays. This evaporated water, water vapor we may call it, is invisible and is lighter than the atmosphere. Therefore it is continually rising, allowing the heavier air above to come down and take up more vapor. The amount of water thus quietly thrown into the atmosphere is enormous. In tropical countries not far from three-quarters of an inch of water a day is carried off from exposed surfaces.

CLOUDS:

As this water vapor rises, it gets into colder regions, and as a consequence condenses into visible masses which we call clouds. Cumulus or wool-pack clouds are often seen with a straight, lower edge resting on an invisible

column of water vapor rising from below. Oftener, however, the water vapor which makes the clouds above us has travelled a great distance, sometimes in the form of clouds, it is true, but sometimes as invisible water vapor.

RAIN:

If these clouds encounter a cold wind, more and more of the water is condensed, and the fine particles of water dust by the law of cohesion are attracted toward each other. They unite, forming drops, which are drawn down to the ground in the form of rain by attraction of gravitation.

Effects of Rain:

Directly or indirectly all the inequalities of the surface of the earth may be traced back to the action of rain. Hills, slopes, plains, valleys, gorges, ravines, all are due to the action of water, and of water ceaselessly flowing back to the ocean only to be reprecipitated again as rain.

Rain makes the greater part of the food of all vegetation, and is absolutely essential to both animal and vegetable life.

SNOW:

If the water vapor reaches freezing air before condensation takes place, then small ice needles, white because they contain air, are formed and are attracted toward each other by a regular rule which results in the formation of many beautiful figures, all of which are built up on the plan of six.

Vegetation is protected by the blankets of snow which cover the colder parts of the country in the winter.

Hail:

If the water vapor does not encounter freezing air until it has condensed into drops, until, in brief, it has become rain, then we have hailstones formed.

Dew:

After the sun goes down, the accumulated heat of the day is given back into the air often more rapidly than it can be drawn up from the ground below. This is particularly true of blades of grass, because of their greatly exposed surface. In consequence, they become cold more quickly than the surrounding atmosphere, and on them is condensed water vapor in the form of dew. Pebbles, however, do not give off heat much more rapidly than they can draw it up, therefore they do not become much colder than the air, and therefore do not have dew formed upon them to any extent. For this reason gravel paths will be dry even in the early morning, while the grass adjoining is wet.

Anything which will keep the heat from radiating from a surface, will keep that surface free from dew. Thus while cobwebs fairly sparkle with dewdrops, the grass beneath is perfectly dry. Clouds act like the cobweb, preventing rapid radiation of heat. Therefore dew is not formed on a cloudy night.

Frost:

This is not frozen dew, but vapor condensed as a solid instead of as a liquid. In its formation it is analogous to snow, not to hail; hence its crystalline form.

Effects of Frost:

Every farmer knows that frost breaks up the ground. For this reason, he often ploughs immediately after a

frost, because then half the work is done for him. But it does more than this. It helps to form the soil by breaking up the rocks.

Methods:

Let the kettle boil again.

Where else have you seen white masses like this? What are they called? From what are the clouds of steam formed? How? From what are clouds formed? How?

When the cold plate was brought in contact with the steam, what happened? Why? What happened to the drops of water? Why? What causes drops of water to form from clouds? Why do these grow larger? Why do they fall as rain?

If the immediate effects of rain on the soil of the school yard were observed in the fall, now will be a most excellent time to review and make coherent the knowledge thus obtained by the children.

If, however, these observations were not made, it will be better to wait until the time of spring showers. For the sake of convenience, however, the method of teaching the effects of rain will be given here.

What kind of a mark did the raindrops make in the soil of the school yard? Why? What became of these drops? What good did the rain that sank into the soil do for the plants? Why? How? What happened to the drops that staid above ground? When they found a channel, what did they do to it? Why is the gutter stream so large? Why is it so dirty? What will happen to this dirt after a while? How do you know? How are rivers formed? What work do they do as

they travel rapidly along? What do they form when they go slowly?

Show the children such pictures as those of the Cañons of the Colorado, and tell them the story of the Mississippi or of the Nile.

For the proper study of snow and frost, the children should have some knowledge of the results of crystallization and the conditions under which it takes place. This is most easily done by allowing a saturated solution of salt in hot water slowly to cool and then to evaporate. Compare the resulting cubes with those found in ordinary cooking salt and in rock salt. The children will at once see that the difference is one of size only. They should be told that the crystals of rock salt are formed when the cooling and evaporation are very slow, so that the particles of salt are not hurried, and are thus free to build up large crystals.

This lesson will be more attractive, perhaps, if, instead of salt, sugar and rock candy are used.

For other suggestions, read the chapters on crystals in Ruskin's "Ethics of the Dust."

The work of frost was illustrated, doubtless, in January, if one of the seed tumblers was placed on the window ledge. The water probably froze, and by its expansion in turning into ice broke the tumbler. Make use of this incident, taking up the work of frost in general.

Dew has already been illustrated by bringing a pitcher of ice water into the warm room. Where is dew formed? What must then be true of the temperature of the blades of grass? Why are they colder? Why does everything get colder at night? What will prevent the formation

of dew? Why? Why do people cover plants with newspapers when they are afraid of a frost?

LITERATURE:

The poems with reference to snow and rain will be found in the weather literature for previous months. See pp. 15, 17, 18, 109.

Stories:

The General Thaw, Mrs. Gatty's Parables from Nature.
Aqua, Kate Douglass Wiggin's The Story Hour.
Story of the Boy and the Haarlem Dike.
Father Aldur, Alice Giberne.
A Drop of Water, Andersen.

Easy Poems:

The Brook, Tennyson.
Little Jack Frost, Walker's Songs and Games.
Jack Frost, Eleanor Smith.
Little Artist, Jack Frost, Frost Pictures, The River, } Lovejoy's Nature in Verse.
Jack Frost, Whittier's Child Life.

More Difficult Poems:

Rain, Margaret Deland.
The Frost Spirit, Whittier.
Mad River, Songo River, } Longfellow.
Fountain, Lowell.
Lodore, Southey.
A Farewell, Tennyson.
Summer Shower, Emily Dickinson.

PLANTS

The study of the germinating seeds outlined in Chap. V. will not be finished until the close of February, or even until March.

In addition to the observation of the growing seeds, such experiments should be performed as will demonstrate clearly to the children that these seeds are alive; that like the animals, they not only grow, but that they also breathe and eat.

Facts:

Plants, like animals, breathe out carbon dioxide. This they do continually, but owing to the oxygen given out in the assimilation of food, a life process which takes place only in the light, respiration is most easily shown with plants that are kept in the dark.

Plants take in nourishment osmotically through their roots. This food consists of water and substances dissolved in it. They are able, however, by means of an acid secretion, to act upon carbonate of lime, which is then available for food.

Method:

It is first necessary to show what breath really is. Let the children breathe against their hands, against a cold surface, such as the board, into a little clear lime water through a straw or glass tube.

Why is the breath warm? What does it contain? What effect has it on the lime water?

The turbidity of the lime water is due to the fact that the carbon dioxide of the breath precipitates lime carbonate, a white solid, and therefore easily seen in the water.

These experiments establish the fact that we breathe out carbon dioxide and water vapor. This is true of all animals. Is it true of plants?

The following experiments will decide these questions and some others:

Place some fresh leaves in a bottle of water, which should then be placed in a fruit jar. Suspend in the same jar a small bottle of clear lime water. Close securely and cover with black paper, or set it in a perfectly dark closet. The jar must be absolutely air tight.

Prepare another jar in the same way, omitting the lime water.

The next day exhibit the first jar.

What has happened to the lime water? Why? Where must the carbon dioxide have come from? What does this indicate?

Into the other jar, lower a bit of burning candle suspended by a wire. Owing to the presence of carbon dioxide it will immediately cease to burn. To show that this is not due to the shape of the jar, introduce the burning candle into a similar empty jar.

In which jar did the candle go out? What is the difference between the two jars? Why, then, do you think that the candle went out in one jar but not in the other? What two tests are there to prove the presence of carbon dioxide?

Set up this experiment in the same way, but put the jar where the leaves will be in a strong light.

Test for carbon dioxide. Explain to the children why this time the candle does not go out. If the aquarium is flourishing and in a good light, they can see the little bubbles of oxygen given off by the plants.

How shall we find out whether seeds breathe?

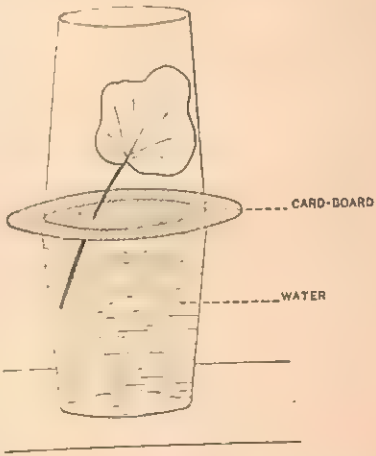
Set up one experiment in the light and the other in

the dark. In both cases carbon dioxide is given off. Why is it that oxygen does not mask the respiration as before? Because, since seeds are not green, no oxygen is produced.

In this experiment peas soaked over night, or, better still, those already germinating, should be used. Fill the jar at least a quarter full, and put in with the seeds pieces of damp blotting paper to keep them moist.

Do plants, like animals, breathe out water vapor?

An experiment arranged as in the accompanying cut will answer the question. Within twenty-four hours the glass above the branches will be covered with drops of water.



Care must be taken to make the upper tumbler air tight; otherwise the water transpired by the plant will be absorbed by the air, and in consequence none will be deposited in the glass. This may be done by fastening the upper tumbler to the pasteboard with asphalt, shellac, or putty.

To demonstrate that plants can feed upon solid lime carbonate, plant a number of soaked peas on a piece of polished marble in earth. At the end of a month,

or, better, two months, remove the marble. On its surface will be found the markings of the roots. These have dissolved the marble by means of an acid of their own manufacture.

SEED FOOD-SUPPLY:

It is, perhaps, an open question how much of the work in plant physiology above given should be taught. Omit all of it, rather than not give some lessons on seed food-supply.

Facts:

Either wrapped around the embryo, or stored away in some of its parts, is food sufficient to supply the needs of the body plant until it is able to get and make food for itself. This may be in the form of starch, oil, proteids, such as the gluten of wheat, or cellulose, of which the hard seed of the date is an example.

Iodine turns wet starch blue or black; oil is easily determined by the stain that it makes on paper. The gluten of wheat may be extracted by chewing it until only the gummy gluten is left. Many seeds — the nutmeg, for example — contain several kinds of food.

Method:

Give the children peanuts. Where do they grow? On what part of the plant are they found? Do the flowers which produce them bloom under the ground, too? Why is this?

How many coats has the peanut? How many parts to the seed? Look closely. Do you find anything connecting these parts? What is it?

Prick the nut. What happens? Of what use is the oil to the seed? Do you know of any people who like

oil and oily foods? Why does the peanut have oil in its seed leaves? Its seed leaves are also full of starch. Do we use starch for food? In what form?

Why does the mother plant provide the baby with so much food? Do you see now how it is that seeds will grow for a long time, apparently with only water to nourish them?

Who else likes the food of the peanut? Tell me some other seeds that are good to eat.

In the second and third years, teach also the iodine test for starch.

Distribute soaked peas, beans, or corn. Tell the children to break them open so as to expose a rough surface. Pass up and down the aisles, putting a drop of the tincture of iodine, by means of a glass rod or small brush, on the seeds, and telling the children to watch closely the result. They ought to be able to tell you that the liquid turns the seeds blue or black; that this was not a solid color, but in numerous small dots.

Ask the name of the liquid, and tell them that it has the power to turn starch blue. What is there in this seed? How is it arranged?

Test wheat in the same way. It also contains starch. But it has also another and more valuable food, which can be discovered by first getting rid of the starch. Let them chew a handful of wheat until it is gummy. Wash away thoroughly all the starch. Test with iodine. This is gluten.

Encourage the children to test for the food-supply of the seeds by themselves.

Valuable language lessons may be given on commercial seeds and fruits.

ANIMALS

The commoner winter residents among the birds of the Middle Atlantic States are the Chickadee, the Snowbird, the Winter Wren, and the Golden-crowned Kinglet. They breed farther north, but come to us at the approach of cold weather, and remain with us all winter.


Chickadee.

Facts:

In general, the birds move southward not only to avoid the cold, but also in search of food. Since it is the young who are most sensitive to cold, and most dependent on food, it often happens that they lead the way in the southern migration.

The CHICKADEE: Its other name, Black-capped Titmouse, describes its appearance. This is one of our most familiar winter birds, coming early and leaving late. It is very sociable and fearless, eating nearly everything, and singing perpetually "Chick-adee-dee," or often in winter "day-day-day." It is about five and a half inches long.

The SNOWBIRD belongs to the Sparrow family. Its general appearance is slate color. It may be easily

recognized by the lateral tail feathers, which are white. Like the chickadee, it frequents dog kennels, and is even more fearless in reference to the human race, coming often into city yards. It measures from six to six and a half inches in length.

Slate-colored Junco, or Snowbird.

The WINTER WREN is less commonly seen than the chickadee and snowbird, because of its shy disposition. It is easily recognized by its saucy tail and long, slender beak, characteristic of all the Wren family.

Its song, which, of course, we never hear, is said by Burroughs to be surpassed by few in brilliancy and plaintiveness.

Its length is about four inches.

The Golden-crowned Kinglet is the second smallest bird in the United States, measuring about four inches. The humming-bird is the smallest, and the winter wren the third in size.

Golden-crowned Kinglet.

The male kinglet may be easily distinguished from his mate by the crown of the head, which in his case is flame color edged with black, and in hers, yellow without the flame colored patch.

In cold winters they often go as far south as Guatemala.

They are especially fond of evergreens, in whose bark they find many insect larva. They are thus very useful to us.

They were at one time much used for decorating women's hats, but the killing of them for this purpose has been stopped by law. Their chief enemy at present is the English sparrow.

Method:

Review the birds already studied, all of whom are residents. Why are they residents? Are all birds residents? Why do some leave us? Where do they go? Who goes first? Why? Do any birds come to us in the winter? Where do they come from? Why? Where do we most commonly see them? Why?

By means of pictures of stuffed birds, teach the children their striking peculiarities, never forgetting the bills and feet and their meanings.

LITERATURE

Stories:

The Birds' Christmas (Chickadee), Emilie Poulsson's In the Child's World.

Poems:

Titmouse, Emerson,
The Snow Bird (Chickadee),
The Snow Bird's Song (Chickadee),
What the Snow Bird Said,
} Lovejoy's Nature in Verse.
The Chickadee, Celia Thaxter.
Snowbird, F. D. Sherman, in Little Folks' Lyrics.
Snowbird, Dora Goodale.

CHAPTER VII

MARCH

Poems:

March, Mrs. Dodge, in St. Nicholas Songs.
March, Wordsworth.
March, Mary E. Blake, in Verses Along the Way.
March, Celia Thaxter.
March Winds, Nora Perry, in New Songs and Ballads.

WEATHER

All the work that can reasonably be done in a preliminary first-year course by children from six to eleven years of age has already been outlined in the preceding chapters of this book.

Begin now to test your own work, and to do over again what you find is not well done.

The children ought to be able to tell at a glance, from many different signs, from what direction the wind is coming, and to give some comparative idea of its velocity. They ought to be able to name the clouds, to explain their origin and probable fate. They ought, within limits, to be able to predict the probable changes in weather. Of each month, and, above all, of the seasons, they should have a mental picture, in which is prominent not only the conditions and kinds of plants and animals, but also the amount of sunshine, the prevailing winds, the clouds most commonly seen, and the temperature.

And this picture should be an integral part of their minds.

Have you gained this yourself, even? Look back over your work, see where and why you have failed. Use to the best advantage the remaining months. Take the children out of doors, if only for a few moments, every day that you can, and take them always with a definite purpose.

PLANTS

Buds:

In early March gather a large handful of buds on branches not less than eight inches in length. Get as many different kinds as possible. Cherry, horse-chestnut, tulip, poplar, lilac, North Carolina poplar, willow, are particularly desirable.

In cutting these from the tree, use pruning scissors, or a knife, and do not take more than a branch from any one part of the tree. Be especially careful not to spoil the horse-chestnut, because the whole year's growth of the branch is wrapped up in the large and very enticing terminal bud.

Pruning scissors are worth buying, since they cost only fifty cents, and save a vast amount of strength and temper, both in securing the buds and caring for them afterwards.

Cut off the ends of every branch under warm water. When finished, keep the jar where it is warm, and, if you choose, add warm water each day. Renew the water at least once a week, cutting off a piece of the stem at the same time.

The Horse-chestnut:

The bud of the horse-chestnut is very sticky, a wise provision against the rains of winter. It is covered with

about seven pairs of opposite scales, all of which appear to be thick, brown, and shiny. When the bud opens, however, it will be found that this is true only of the exposed tips of the inner scales. The part covered up is green and soft. Moreover, when they lap together, they are rather woolly. Inside the scales are one, two, or even three pairs of very woolly, tightly folded, opposite leaves. In the centre may often be found a compact, woolly flower cluster.

Horse-chestnut branch.

Cause of the Horse-shoes.

Horse-chestnut buds.

The leaves look at first like rather clumsy small spoons, then like a hand with from five to seven fingers. At last, when the wool begins to drop off, they show that they are palmately compound leaves.

The horseshoe-like scars below the bud are the marks left by last year's falling leaves. Observe that they are opposite. The nails indicate the number of leaflets. This

is typically seven, but owing to hybridization with the buckeyes, five, six, seven, and even eight or nine are occasionally found.

Usually between every two pairs of leaf scars will be found rings. These mark the place where the bud scales dropped off, and therefore between them is a year's growth. Observe that some years the branch grew much more rapidly than others. Why?

Method:

Nothing could be better for the children than for each to have his own branch, with his name cut on it, to watch it from day to day and to draw it. But this is not often practicable. Moreover, it would be bad for the trees.

Much can be accomplished, even in a large school, with a single branch, if only the teacher knows, if only she is in earnest.

Review what the children learned of the buds in early fall. Why do we cut off their ends? Why do we place them in warm water? Why are the buds sticky?

As they develop, give the children a hektograph drawing of each stage.

How do the inner scales differ from the outer ones? Why are the latter brown? Why leathery? Why are the inner ones brown and leathery at the outside tip? Why green elsewhere? Why slightly woolly?

What is inside the scales? Why do you think that these are leaves? Why are they woolly? Why so folded together? What kind of leaves? How many leaflets?

Look at the stem. Do you see any signs of last year's leaves? What are the dots? Do you find any signs of

last year's bud scars? How many pairs of leaves were wrapped up in this year's bud? In last year's? How old is your branch?

CHERRY (the cultivated):

The leaf buds are smaller and longer than the flower buds. The former are terminal, or nearly so, while the latter are always axillary. The flower buds develop first. There are two or three flowers in each bud, and their stems are usually much shorter than those that develop normally on the trees.

LILAC:

The buds are four sided. Usually, two terminate the branch. The scales are green and leaf-like. Indeed, as they open, the transition from the scale to the leaf proper is gradual, but very noticeable. The lilac always develops well, and is therefore satisfactory. Moreover, it is often possible to obtain a sufficient quantity for the individual use of an entire class.

Bud of the Tulip Poplar.

THE TULIP TREE:

When these can be obtained at all, they are to be had in abundance, and, if carefully cut, the tree will not be injured. They are one of the prettiest buds in development, and the most satisfactory of all except, of course, the horse-chestnut, to pull apart. This may be done later, when the buds are at their largest, with a pin, or, better still, a penknife.

The cut shows perfectly the gradual development from the bud. Notice, particularly, the folding and position of the leaves, and the fact that there is often a bud within a bud.

POPLAR:

The buds of either the North Carolina or the balsam

Leaf and flower bud. Balm of Gilead — Balsam Poplar.

poplar will answer equally well. They are very easily obtained in a city, both because they are common as street trees, and because, at this time of the year, vandals go about "trimming the trees" and throwing on the ground an abundance of living branches.

The branches often root in the schoolroom, thus illustrating why these trees are so frequently grown. Like

the willow, it is only necessary to plant a branch in order to have a tree.

The terminal buds contain the leaves. These do not come out until after the flowers. The axillary buds may contain either leaves or flowers. The leaf buds are much more sticky than the flower buds.

The male flower clusters, familiarly called caterpillars, are made up of flowers consisting of numerous large stamens. Where are the pistils? How does the flower dust get to the pistils? Has this anything to do with the fact that the flowers come before the leaves?

The leaves are very neatly and compactly arranged in the bud, each margin being rolled inwards.

Willow:

The willow belongs to the same family as the poplars, and, like them, the flowers, familiarly called pussy willows, come in most kinds before the leaves. Like the poplars, too, the male, or staminate flowers, are more frequently found. They should be put in water, and attention called to the yellow stamens and abundant pollen. The poplars are fertilized by the wind, but the willows depend upon insects.

Methods:

The methods indicated for the horse-chestnut should be pursued with these branches. Do not study too many of them, nor any of them too minutely.

Remember that the object of these lessons is to open the eyes of the children to the joys of spring, when, later, the buds begin to develop out of doors.

Ripe Pussy Willow (stamens), one flower enlarged.

Ripe Pussy Willow (pistils), one flower enlarged. Pussy Willow. Seed.

LITERATURE

Stories:

Baby Buds, Winter Clothes, Emilie Poulsson's In the Child's World.

Easy Poems:

Pussy Willow, In the Child's World.

The Sunshine's Caress,
Pussy Willow, } Lovejoy's Nature in Verse.
Miss Willow,

SEED FOOD-SUPPLY.

Facts:

Whatever may be the form in which the food for the little plant has been stored up for the winter, before it is available it must be changed to sugar. This is accomplished by the action of a ferment, the other requisites being moisture and warmth.

Methods:

Soak over night a quantity of barley. Plant it the next day in damp sawdust. At the end of a few days the roots will be about half an inch in length. Take out half of the grain, when they have reached this stage, wash away quickly the sawdust, spread them out, and put them in an oven to dry.

Allow the others to grow until the green leaves are developed. Wash and dry.

Give to the children some grains of ungerminated barley, the dried germinated barley, and the seedlings.

What is the seed food-supply in barley? How do you know? Taste it.

Taste the germinated barley. What difference do you notice? What does this mean?

Taste the seedlings. What has become of the sugar?

Just the same thing happens with your own food. All the starch is changed into sugar, a part of it in the mouth.

GERMINATION:

The seeds which were planted in January must by this time have grown as much as they will, unless they are planted in earth. This should be done.

In the bottom of a flower-pot put a few pieces of broken crockery for drainage, then fill the pot to within an inch of the top with good light earth. In transplanting, be particularly careful not to injure the roots.

SOIL.

The greater portion of the United States has a soil made by the disintegration of rocks. The sandstones and shales give rise to a red or white soil, which is plainly seen to be due to the adjacent rocks; while particles of shining mica show the relationship of that soil to the surrounding gneiss, mica schist, or granite.

In addition to mica, it is very easy to separate out the other ingredients common to granite and other soil, viz., clay, coarse and fine sand, and decayed vegetable matter. The decay of the mother rock may have been caused in various ways. The surest and commonest way in which a rock is destroyed is by the freezing of water which has soaked into it, and which in the freezing expands, forcing off small fragments.

In desert regions where the difference between the day and night temperatures is enormous, travellers often hear the rocks crack, and even see the chips fly, in consequence of the inability of the rock to adapt itself to the rapid contraction and expansion which result from sudden changes of temperature, even when no ice is formed. This same cause results in rock disintegration in all parts of the world.

Still another cause of the decay of rocks and consequent production of soil is shown by the yellow stain so commonly seen, which means merely that the iron is oxidizing, or changing to iron rust. In the case of gneiss and mica schist, this oxidizing of the iron results in

the disintegration of the mica and consequent breaking of the rock itself.

Mica:

The commonest of all the micas is white mica, or muscovite; the next, black mica, or biotite. Both of these are found in flat, six-sided forms, made up of very thin, transparent, elastic layers. Both are quite soft, being easily scratched with the finger nail. White mica may be white, gray, or, less frequently, brown or yellow. Black mica is deep black to green. Moreover, it is almost opaque when viewed in one direction, and transparent and of a different color, when viewed in another direction. Mica is used in stove doors, for window glass in Siberia, for covering compass boxes, for frost work at Christmas time, and sometimes, like graphite, for lubricating machinery.

Sand:

The next most evident thing in soil is usually sand. The grains are easily picked out, and will be found to vary in color, some being transparent; others, milky white; others, still, yellow. They are all grains of quartz, hard, therefore, and gritty. They have rubbed against each other until they have lost their sharp angles. Sand is used in the manufacture of glass, plaster, mortar, and for scouring and moulding.

Clay:

The clay in soil may be easily recognized by its characteristic odor, particularly when wet. It is, in most instances, derived from disintegrated feldspar. The presence of too much clay in the soil makes it stiff and

impervious to water, while with sand alone the water would pass too quickly through. A mixture of sand and clay is the best for the farmer.

Out of the clay is made porcelain, china, crockery, flower-pots, bricks, drain-pipes.

Quartz and Pebbles:

Milky quartz in the form of white pebbles may be found in abundance in most streams, and may be bought at aquarium supply stores. Frequently mixed with them are feldspar pebbles which, however, are rather softer and may be scratched, usually with difficulty, with a knife.

All of the quartz pebbles will be found to be hard, easily scratching glass, light in weight, with a glassy lustre, transparent or translucent, or even opaque, breaking irregularly.

The green color of some of the pebbles is due to plants grown in their former habitat — a stream of water; and the yellow color of others, to the presence of iron which has rusted.

All pebbles began their existence as angular pieces of rock. They have become rounded by dint of being rubbed against each other in water. Glacial pebbles, which are common enough in gravel pits and north of the line of the terminal moraine in the ice age, have of course been rounded by being rubbed along by the glaciers of that period. They are often scratched.

Because of the great hardness of quartz and its lack of susceptibility to chemical change, we seldom have it reduced to anything finer than sand, while feldspar is finally reduced to impalpable clay.

Quartz crystals are built up on the plan of six, typically a six-sided right prism, capped on both ends with

a six-sided pyramid; but this typical form is rarely seen. Often there are only the pyramids. This is called drusy quartz. The form most commonly seen is the prism terminated with a pyramid. Quartz crystals, when colored violet or purple, are known as amethysts.

Other well-known forms of quartz are rose quartz, smoky quartz, yellow quartz, agate, chalcedony, carnelian, opal, onyx, flint, jaspar. The stiffness of grass blades and the grain is due to silica or quartz.

Some of the uses of quartz have already been given under the head of Sand. Rock crystal was once used extensively for the best spectacles. What the boys call "reallys" (marbles) are made from agate, which is used, too, for various ornamental purposes, as are also carnelian, amethyst, jaspar, chalcedony, onyx, and opal. From flint were made the Indian arrow heads. The white men used it for striking a fire.

FELDSPAR:

The commonest feldspar is that known to mineralogists as orthoclase. It is softer than quartz, harder than glass, ranging from six to seven in a scale of hardness, which is as follows:

1. Chalk, Talc, Graphite.
2. White Mica, Rock Salt.
3. Calcite.
4. Fluorite.
5. Glass.
6. Feldspar (usually).
7. Quartz.
8. Beryl.
9. Corundum.
10. Diamond.

Feldspar has a pearly lustre and two planes of cleavage, one at right angles to the other, or, as the children say, it breaks in steps. Its color is usually light, ranging from white to gray, pink, red, brown, and green. It is the mineral which gives granites their characteristic colors.

As moonstone, it is somewhat used for ornaments. Its other uses have been given under the head of Clay.

Methods:

After the seeds have been planted in the earth, give to each child a small box half full of soil, or distribute it by the spoonfuls on pieces of paper already laid out on their desks.

Put into one pile all the gravel that you can find. What color is it? What shape? Why? On the ground which would you find on top, the gravel or the fine soil? Why?

Sort over the rest of the soil. What do you find next in size to the gravel? What is it called? Put in another pile the grains of sand. What colors? What shape? Hard or soft? How do you know?

Let the teacher or the pupils drop a little water on what is left. What is the odor that you now notice?

What else is there besides the gravel, sand, clay, in your soil? Describe it. They are sure to find all sorts of interesting things, — mica, grasshopper's eggs, bits of leaves and roots, earthworm castings, etc. Let them think out the reasons for the presence of whatever they find.

If mica is in the soil, lessons on that mineral will be very interesting to the children.

An excellent plan is to ask the children questions,

giving them time always to observe their specimens, and to think out the answers, but not allowing them to answer orally. Then giving them each paper, let them write all that they can.

For mica the following questions might be used: What is the color of your specimen? Hold it up to the light. Has it the same color? Try to scratch it with your finger nail. Is it hard or soft? Separate it into thin layers. Hold these to the light. What can you see through it?

Teach the words "transparent," "structure." Teach them the uses of mica, and show them how it happens to be in the soil. It is usually perfectly easy to get a series of specimens of gneiss and mica schist, showing all the transitions from the hard to the softer rock and to soil.

Questions on quartz pebbles: Scratch it with your finger nail, with a penknife. Try to scratch glass with it. Is it hard or soft? What shape? Why? How hard? What color? Is it transparent? Let the light shine on it. Does it shine like glass, or is it softer like pearls? What is its structure? Does it break regularly or irregularly?

Review "structure" and "transparent." Teach the words "translucent," "opaque," "lustre." Teach part of the scale of hardness, namely, 1, 2, 5, 7.

Procure as many different kinds of quartz as possible. Mix up with these crystals of rock salt, rock candy, calcite, fluorite, feldspar, anything, indeed, similar in appearance to quartz, and let them learn to distinguish one from the other. This is easily done by testing the hardness. The peculiar crystalline structure of quartz should be thoroughly taught.

Excellent language and reading lessons may be had on the various uses of the different kinds of quartz, and particularly on the history and manufacture of glass.

If possible, begin now a mineral collection. Get the largest and best specimens that can be obtained. Arrange these minerals in families as much as possible, and secure specimens illustrating their uses. The labels should contain not only the name, but also the locality from which the mineral came. Let the children contribute the greater number of specimens and do the greater portion of the work. But the teacher must both give and work, if she expects to have a successful collection of any kind.

Feldspar is the commonest of all stones except quartz. Beautiful specimens may be bought for a small sum.

By this time, each child should possess a piece of glass, a penknife, or a bit of sharp steel, and should have sufficient knowledge of the subject to be able, without questions, to write a description of the mineral under these heads: Weight, Structure, Color, Transparency, Hardness.

Teach them the term "cleavage."

The uses of clay and its independent discovery by different nations for the manufacture of pottery, an excursion to a brick yard, or in default of this, the comparison of brick clay, an unbaked brick, which may be afterwards baked, and a baked brick, all easily procured by the teacher, will make excellent supplementary lessons.

Review thoroughly and compare the three minerals,— mica, feldspar, quartz. In what form does each exist in the soil? Of what use is each to the soil? Why?

LITERATURE

The stories and poems, illustrating the power of water and frost, already given under these heads are appropriate here:

Stony and Rocky, Emilie Poulsson's In the Child's World.
Pebbles, Lovejoy's Nature in Verse.

ANIMALS

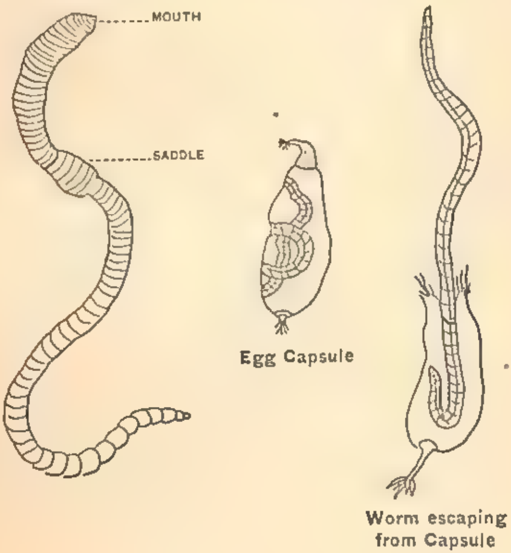
WORMS:

One of the earliest signs of spring is the presence in the morning of fresh earthworm castings. They are to be found everywhere, both in the city and in the country, and tell a great deal of the life history of a most interesting animal.

The thin iridescent cuticle of the earthworm is chitinous or horny. The rings are much larger in front and rather flattened at the other end, which commonly remains in the burrow. Along the back and underneath may be seen blood-vessels. The bristles, by means of which it moves, are arranged in double rows along each side of the ventral surface of the body. Every segment, except the first and last, has four pairs of bristles.

The popular opinion, that each part of a bisected earthworm walks off and becomes a new worm, is not true. Only the head portion is capable of regenerating the other part. Although not so low in the scale as this prevalent superstition would indicate, they cannot see or hear, and have only a feeble sense of smell, as Darwin's and Henson's many experiments prove. They show some intelligence in lining their burrows, usually seizing leaves, etc., by their pointed ends. Leaves serve not only to line and to plug the burrow, but also for food.

They feed, likewise, upon the organic matter in the soil, which they swallow in great quantities, and eject in the form of the familiar "castings." They are extraordinarily numerous in all humid regions, a fact that we scarcely realize because they live in their burrows during the day, emerging only at night for food and to work. In cold or dry weather they are entirely quiescent.



It has been estimated that about ten tons of earth in each acre of ground pass annually through their bodies in places where they are numerous. By this means fresh surfaces are kept continually exposed to the action of carbon dioxide and the humus acids, and thus decomposed and disintegrated.

Moreover, these "castings" are distributed either by

rolling or by the action of the wind or by rain, so that the worms are thus constantly levelling the surface of the earth.

Worms prepare the ground excellently for seedlings. They sift the soil, so that no stones larger than they can swallow are left in it. They mix it, as does a gardener who wishes to prepare fine soil for his choicest plants. They cover up bones, etc., thus bringing them in a more or less decayed state within reach of the roots. They cover seeds which lie upon the surface, thus giving the radicle a leverage; and, last of all, their burrows facilitate the penetration of the roots.

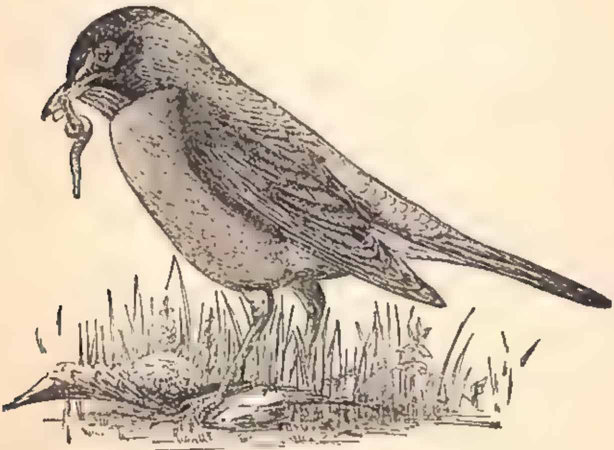
Says Darwin: "The plough is one of the most ancient and most valuable of man's inventions; but, long before he existed, the land was, in fact, regularly ploughed by earth worms. It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly organized creatures."

BIRDS:

Stray robins and bluebirds remain with us in Philadelphia all winter. In the latter part of February those who have gone farther south begin to straggle up, staying with us for a short time, but usually going further north. In March, the robins, bluebirds, and crow blackbirds become quite common. The red-winged blackbird and the meadow lark are also to be found in their favorite haunts.

All of these birds eat insects, a story plainly revealed by their long, narrow bills. They are, of course, all perchers.

The American Robin, when it first comes from the south, sings most freely at noon or in the afternoon; but later, when the weather is mild enough to warrant such early rising, it begins its song at dawn. It is not a very intelligent bird, often building its heavy, bulky, mud-lined nests on branches not capable of supporting such a weight.



American Robin.

The eggs, perhaps the best known of all birds' eggs, are four in number, and of that peculiar blue green color, known as robin's egg blue.

The robin belongs to the Thrush family; its usual length is ten inches.

Bluebird: These birds are found only in America. The coloring of the male is much more vivid than that of its

mate. Both, however, are blue above and rusty red underneath. "When Nature made the Bluebird," says Burroughs, in "Wake Robin," "she wished to propitiate both the earth and sky, so she gave him the color of

Bluebird.

one on his back and the hue of the other on his breast, and ordained that his appearance in the spring should denote that the strife and war between these two elements was at an end. He is the peace harbinger; in him the celestial and terrestial strike hands and are fast friends."

The bluebird measures seven inches. In building the nest, they choose by preference a bird house, a hole in a tree, or some place that will afford the children sufficient protection without too much exertion on their part. Their eggs are pale blue, from four to six in number.

They, too, belong to the Thrush family; but their song is more like the Warblers'.

Crow Blackbird: These are the largest of all the

Crow Blackbird, or the Purple Grackle.

spring birds mentioned, measuring from twelve to thirteen inches in length.

The color is iridescent black; their eyes, conspicuously yellow. They journey in immense flocks, their discordant cry and peculiar manner of flying making them a very prominent feature of the landscape.

Their nests are well built, and their eggs, which vary greatly, are peculiarly marked and streaked, brown on a light-colored groundwork. They are universally hated by the farmer, who unjustly accuses them of destroying his cornfield. They help him, however, by destroying great quantities of insects. They are sometimes called Keel birds, from the use which they make of the tail in flying, and sometimes the Purple Grackle.

Bird Migrations:

To this most interesting subject, allusion has been already made, but it seems worth while again to state some of the facts. It is a subject much discussed and not even yet thoroughly investigated.

There are, popularly speaking, three classes of birds in any given locality, — permanent residents, migrants from the south, migrants from the north. These terms are only relative, since the so-called permanent residents travel about more or less extensively during the cold season, and even the truly migratory birds of one locality may be residents in another.

The great cause of migration is probably failure in the food-supply. Therefore, in many families, it is the young who initiate the southward migration; but it is the male, urged on by his nest-building, family-founding instinct, who is the first to return to the north. In most

cases, the birds pursue the same path year after year, and it is a very common observation that they even return to the same tree season after season. As Weissmann says, they have "an inherited talent for geography"; and, in addition to this, their method of flight, high in the air, gives them a bird's-eye view of the country beneath, enabling them to use as landmarks what to us below are simply indistinguishable parts of a mixed and complete whole.

Three or four times as many birds leave us in the fall as return to us in the spring, so that the loss of life in migrations must be large.

Method:

In preparing the children to study the earthworm, take them out with the avowed purpose of finding signs of spring. These, of course, will be the buds and the earthworm castings. Tell the children to bring in as many different kinds of the latter as they can find. They will gather all sizes and shapes, wet ones and those which have dried.

Describe what you have brought in. Why are some of them moist while others are dry? Where did they come from?

City children are often unable to answer the last question, and I have, in consequence, usually suspended the lesson here, sometimes telling them that if they wished to know, they might find out if they watered the place towards dusk, and watched to see what animal came out. This little experiment explains to them what they have already observed — the numerous earthworms to be seen in the spring mornings after a storm.

Earthworms may be kept in a pot in the schoolroom, fed on cabbage leaves and other vegetables, of which they are very fond. The pot should be kept fairly moist. Cover it with a piece of glass and black paper; then when the latter is suddenly removed, they may be seen at work.

Strangely enough, children do not seem to object to touching earthworms, but bring in willingly many specimens. They should not be allowed to handle them, however, on the earthworm's account, not on theirs.

If the teacher shall deem it advisable, each child may have a specimen to study, keeping it in a small box partly filled with moist earth.

About how long is the earthworm? Where is it largest round? What difference between the head and tail end? How does it move? What does the saddle look like? What color is the skin? What difference in color between the upper and lower sides? Between the head end and the tail end? Why?

Notice the blood-vessel in the back. Which way does the blood travel? How many beats per minute?

In the study of the birds procure nests and stuffed birds if possible. If not, colored pictures will answer.

In each case let the children determine the habit and the food of the animal by the study of its beak and feet.

Get from them their own experience and observation of the particular bird under consideration, and add to these your own.

LITERATURE

The usual reading books are full of stories of the birds.

Adaptations from Ruskin's Queen of the Air and Burrough's books, notably Wake Robin, are possible.

Little Brothers of the Air, Olive Thorne Miller, and Merriam's Birds through an Opera Glass give suitable stories for children.

Seaside and Wayside, No. II., has an interesting account of the earthworm.

Additional Stories and Myths:

How the Robin Got his Red Breast, Indian Myth, Whittier.
The Unknown Land, Mrs. Gatty's Parables from Nature.
The Storks, Andersen.
Birds of Killingworth, Longfellow's Tales of a Wayside Inn.
The Little Worm that was Glad to be Alive, Elizabeth Peabody, Emilie Poulsson's In the Child's World.

Easy Poems:

Out of the Sky,
The Secret,
How the Birds First Learn to Sing, } Mrs. Dodge's When Life is Young.
Birds' Thoughts, Emilie Poulsson's In the Child's World.
Morning Song, Tennyson, from Sea Dreams.
The Coming of Spring,
Brother Robin,
A Song of Spring,
If Ever I See, Lydia Maria Child,
A Bird's Nest, } Lovejoy's Nature in Verse.
Bluebird,
Birdie's Ball, } Walker's Songs and Games.
All the Birds Have Come Again, Eleanor Smith's Songs for Little Children.
If the Bluebirds Bloomed, St. Nicholas Songs.

More Difficult Poems:

Sir Robin,
Sister and Blue Bird, } Lucy Larcom.

In the Lilac Bush (Robin), The Robin, } Celia Thaxter.
Return of the Birds, Bryant.
Trumpeter Redbreast, from Lilliput Levee.
Extract from Owl Against Robin, Sidney Lanier.
Winter Robin, Robin Badfellow, Robin, } T. B. Aldrich.
Warbling of the Black Birds, Jean Ingelow.
Bluebird, Whittier's Child Life.
Robin, Bluebird, } Emily Dickinson.
A September Robin, Miss Mulock.
A Remembrance of Autumn, Adelaide Procter.

CHAPTER VIII

APRIL

Easy Poems:

Now the Noisy Winds are Still, } Mrs. Dodge's When Life is
An April Girl, } Young.
April Showers, Lovejoy's Nature in Verse.
April, Songs for Little Children, Eleanor Smith.

More Difficult Poems:

In April, } Lovejoy's Nature in Verse.
April Fools, }
April, Alice Cary.
An April Welcome, Phœbe Cary.
April Day, Longfellow.
April, Whittier.
April, F. D. Sherman, in Little Folks' Lyrics.
April, Helen Hunt Jackson.

SPRING.

Myths and Stories:

Ceres and Proserpine.
Brynhild.
White Man's Foot, Hiawatha.
Sleeping Beauty.
Legend of the Spring Beauty, Emerson's Indian Myths.

Easy Poems:

The Sap Has Begun to Flow, } Eleanor Smith's Songs for Little
Spring Song, No. I., } Children.

Spring Song, No. II., } Eleanor Smith's Songs for
All the Birds Have Come Again, } Little Children.
Out of the Sky, Mrs. Dodge's When Life is Young.
Spring Song,
A Spring Song,
A Spring Meeting,
A Song of Spring, } Lovejoy's Nature in Verse.

More Difficult Poems:

A Song of Easter, Celia Thaxter.
Extracts From the Progress of Spring,
Early Spring, } Tennyson.
Extract from the Song of the Sower,
Extract from the New and the Old,
Return of the Birds, } Bryant.
Return of Spring, Longfellow.
The First Flowers, Whittier.

STONES

GRANITE.

Facts:

Granite is an igneous, Plutonic rock; that is to say, it was formed by the action of fire in the bowels of the earth, the kingdom of Pluto. Just how it was made is still a matter of dispute. It has been generally supposed to be the oldest of all the rocks, the foundation stone of the earth, because it is known to constitute whole mountain ranges. Nevertheless granite is sometimes formed to-day from the molten mass thrown out of volcanoes. Still, there can be no question that granite is of very ancient origin.

Because of its crystalline structure, we know that it must have been originally a highly heated, molten mass, which cooled slowly. By reason of its compactness,

we judge that the cooling must have taken place under great pressure.

The essential constituents of granite are feldspar and quartz. Usually either mica or hornblende is present, more commonly the former.

Feldspar is always the most prominent constituent, and gives to the granite its distinctive color, — white, gray, red, pink.

Method:

This stone is so much used for building that pieces of it are easily procured in sufficient quantities.

Is this rock made up of one or several minerals? How many? What colors? Investigate the black mineral. Is it hard or soft? What is its structure? its lustre? its name? Investigate the pink. What is its name? How do you know? Investigate the third mineral. What is its name? How do you know?

Of what, then, is granite composed? Where is it found? What is it used for? Why? Does it ever make soil? How? Describe the appearances of this soil.

GNEISS.

Facts:

This is the commonest and therefore the most important of all the rocks. It is undeniably of very ancient origin; but whether of aqueous or igneous structure is not yet settled. It is often found with the habit of granite, and even passing into it by gradual transitions. It is also often found with the habit of an aqueous rock, of which, indeed, it may be only a metamorphosis.

Like granite, it is composed of feldspar, quartz, and

mica; but the mica is more abundant than in granite, and is, in the typical gneiss, arranged in layers. Because of this layering, gneiss is not nearly so valuable a building stone, since it tends to break and to disintegrate along the line of the soft mineral.

Method:

The probabilities are that long before you are ready to teach gneiss, the children will have brought in specimens. The freshly broken specimens are pretty enough to attract them; and in city streets, where building of any sort is going on, large heaps of gneiss are to be found.

In what respect is this stone like granite? How different? Is it as good a building stone as granite? Why not? Does it make soil? How? What does this soil look like?

MICA SCHIST.

Facts:

The origin of mica schist is wrapped in the same obscurity that surrounds that of gneiss.

It differs from gneiss in the presence of a much greater quantity of mica, occurring in larger pieces and in wider layers. Quartz may be present, or feldspar, or both. It is very apt to contain other minerals, such as garnets.

Because of the abundance and the arrangement of the mica, it has small value as a building stone.

Method:

Specimens of mica schist are almost as easily found as those of gneiss.

In what respects is this stone like granite? How

different from it? Like gneiss? Different from it? Is it used for building? Why not? For what is it used?

Does mica schist make soil? How? What kind of soil?

PLANTS

BUDS:

If the teacher has secured, properly cared for, and used the unopened buds of March, she has prepared the children for the delights of watching the growing living green of the twigs and buds of April.

Frequent short excursions should be made to the different trees of the neighborhood, and some time devoted to letting the children tell of other buds which they are watching at home or on the way to school.

After the buds have opened will be an excellent time to begin the systematic study of whatever trees may be in the neighborhood. The teacher must search for them and study them herself. To help her in this, I give below short accounts of the commoner trees.

AMERICAN LINDEN, OR BASSWOOD (Tilia Americana):

> "And all around the Lime feathers low,—
> The Lime, a summer home of murmurous wings."

Most of the characteristics of the leaf, its veining and margin, of the flower, fruit, and tree are sufficiently shown by the drawings.

In addition to these, notice, in living specimens, the tiny tufts of russet down in the axils of the veins on the under side of the leaf; the smooth bark; the fragrance of the flowers, which are full of honey and very attractive to bees; and the long, ribbon-like bract, which aids in the wind distribution of the fruits. Its wood is light

and tough. It is much used for the panels of carriages and wagons and the sounding-boards of pianos. It is the best wood for carving.

> "Smooth Linden best obeys
> The carver's chisel; best his curious work
> Displays in nicest touches."

Most of the famous carvings at Windsor Castle, Chatsworth House, St. Paul's, were made in linden wood.

Linden leaves and flowers.

It makes an excellent charcoal. Its inner bark is used, to some extent, in the manufacture of coarse ropes. It was from the long fibres of this bark that the tree received its name — line tree, or linden.

The handsomest street of Berlin, Unter den Linden, was so called from its double row of these trees.

In Freiburg there still stands a very ancient linden supported by stone pillars. Through its hollow trunk grows a younger tree, presumably a scion of the older one.

The story is, that the parent came originally from a twig carried by a young native, who, in his anxiety to bring the good news of the victory of Morat back to Freiburg, forgot his wounds and weakness. He had only the strength to gasp out, "Victory," before he died. This same story is paraphrased from Euripides by Browning in the "Dramatic Idylls."

An old tree in Germany has given its name to the town. No one knows its age, but its trunk is nearly sixty feet in circumference; and its branches, extending in every direction a hundred feet, are supported by at least a hundred pillars of wood and stone.

THE AMERICAN ELM (Ulmus Americana):

The great beauty of this tree is due partly to the arching character of its boughs, and partly to the fringed appearance of its drooping branchlets. These peculiarities give to it a distinctive grace, enabling any one to recognize the tree, even at night or in winter.

In addition to the shape, the margin, and the veining of the leaf shown in the drawing, notice, in the living specimen, the harshness of the texture of the leaf.

The flowers appear before the leaves, and even the winged fruit is mature before their full expansion.

Its wood, very hard and strong, is preferred to any for the hubs of wheels.

Elm trees are characteristic features in New England

landscapes. New Haven is often called the City of Elms, but many other New England towns are shaded by avenues of elms of almost equal beauty.

It was under an elm tree, still standing in Cambridge, that Washington took command of the American army, July 3, 1775. Under another elm — probably the European elm — Penn concluded his famous treaty with the Indians on the Delaware near Philadelphia.

The European elm, often seen here in cultivation, lacks the grace and distinction of its American cousin. It seldom attains a greater height than fifty feet in this country, but in England it is a noble tree. No one who has been to Windsor Castle will ever forget the avenue of

elms planted by Charles the Second, — sixteen hundred and sixty of them, the number marking the date of his accession to the throne.

The bark of the slippery elm is well known. The tree has the characteristic elm leaf, but is larger and much rougher than the American elm.

THE BIRCHES:

The drawing of the leaf of either the red, yellow, or black birch resembles that of the elms, but the leaves themselves, instead of being rough and hairy, are shiny.

The leaves of the cut-leaved European birch, of the white birch, and of the canoe birch are very unlike the others. There is, however, no difficulty in picking out members of the Birch family, since the bark of all of them has the unmistakable horizontal markings so noticeable in the bark of canoe birch.

The birches are graceful trees. Several of them are valuable for timber, and most of them for fuel. One of them gives the oil to which is due the distinctive odor of Russia leather. All of them are beautiful ornaments in any landscape.

The white birch (*Betula populifolia*) is the one most likely to be seen in the city, partly because of its rapid growth, even in unfavorable situations, and partly because its light and airy grace and the beautiful green of its leaves make it a desirable addition to lawns.

"Most beautiful of forest trees,
The Lady of the woods."

White or Gray Birch.

Paper or Canoe Birch.

The canoe or paper (*B. papyracea*) is the best known of all the birches, because of its striking white bark which separates easily from the trees, and lends itself to many uses.

Of this Michaux gives an interesting account:

"In Canada and in the district of Maine, the country people place large pieces of it immediately below the shingles of the roof, to form a more impenetrable covering for their houses; baskets, boxes, and portfolios are made of it, which are sometimes embroidered with silks

of different colors; divided into very thin sheets, it forms a substitute for paper, and placed between the soles of the shoes, and in the crown of the hat, it is a defence against humidity. But the most important purposes to which it is applied, and one in which it is replaced by the bark of no other tree, is the construction of canoes. To procure proper pieces, the largest and smoothest trunks are selected. In the spring two circular incisions are made several feet apart, and two longitudinal ones on opposite sides of the tree, after which, by introducing a wooden wedge, the bark is easily detached. These plates are usually ten or twelve feet long, and two feet nine inches broad. To form the canoe, they are stitched together with fibrous roots of the white spruce, about the size of a quill, which are deprived of the bark, split, and suppled in water. The seams are coated with resin of the balm of Gilead. Great use is made of these canoes by the savages and the French Canadians in their long journeys into the interior of the country; they are very light and are easily transported from one lake or river to another, which is called the portage. A canoe, calculated for four persons with their baggage, weighs from forty to fifty pounds. Some of them are made to carry fifteen passengers."

Birch bark was also used for "rind tents" in the settlement of the Hudson Bay Company. These were sewed together with the white spruce roots, and were used the whole year round, requiring but a short time — a half hour — to pitch, and being an efficient protection against both the cold and the sun.

The black birch, often called cherry birch, may be immediately recognized by the birchlike appearance of

the bark, and the agreeable spicy odor and taste of both bark and leaves. It is found most frequently in the mountains, and is highly valued for its wood, which is extremely beautiful, much used for furniture and also for fuel.

THE POPLARS AND THE WILLOWS:

These trees form a natural family of striking characters, and have many and important uses. Both are remarkable for the size and length of their roots, for their fondness for water, for their easy propagation, and for their hold on life.

Their buds, flowers, and methods of fertilization have been already spoken of.

The best-known poplars are the Balsam Poplar (*Populus balsamifera* var. *candicans*), North Carolina Poplar (*P. monilifera*), the White Poplar (*P. alba*), and in some places the Lombardy Poplar (*P. dilatata*), and the Aspen, or Popple (*P. tremuloides*), as it is called by the country people.

The balsam poplar is a great favorite in cities, because it makes a good-sized tree sooner and more surely than any other. But its branches are very brittle, breaking in the wind, and its roots are apt to find, penetrate, and fill up any but iron drainpipes.

Its fragrant buds are very attractive in the spring, and also its reddish, caterpillar-like flowers. Nevertheless it would be better to use it chiefly to act as a screen and shelter to young and more valuable trees.

The Carolina poplar, also known as the necklace poplar, because of the resemblance of its long catkin of matured fruits to the beads of a necklace, has also been called, for obvious reasons, the Virginia, the Swiss, and

the black Italian poplar. In general appearance it resembles the balsam poplar; the chief difference between

North Carolina Poplar.

White Poplar.

the trees lies in the fact that the buds of the Carolina poplar are almost free from balsam.

The bark and leaf of the white poplar are markedly different from any of the others. The bark is bright in color, but much roughened with black markings. The leaves are white and downy underneath.

It is said that when Hercules destroyed the robber, Cacus, in the cavern, on a poplar-covered mountain, he was so full of joy at his success that he tore a branch from a tree and wound it around his head. Soon afterwards he visited the infernal regions, where the smoke blackened the upper and exposed side of the leaves, while the under side were bleached by the perspiration of his forehead.

Lombardy Poplar.

It is currently believed that when the tree turns the white side towards you, it is a sign of rain.

The Lombardy poplar is one of the most picturesque of all our trees, slender, tall, with upward pointing branches. It does not produce seed. It is said to have been planted by the French wherever they have settled. It is the hero of the legend of the Poplar Tree and the Pot of Gold.

The American aspen is characterized by the restless quivering motion of its leaves, due to the long, slender

leaf stalks and common to all the poplars, although more marked in this species. This movement has been compared to that of women's tongues "which seldom cease wagging."

Homer says of Penelope's maidens:

> "Their busy fingers wove
> Like poplar leaves when Zephyr fans the grove."

Every one knows Scott's

> "And variable as the shade
> By the light quivering Aspen made."

The wood of the poplars is chiefly used for charcoal and for paper pulp.

The WILLOWS have hybridized so much that it is often difficult to separate from each other the different species.

Black Willow.

Goat Willow

Weeping Willow

White Willow.

Crack Willow.

Long Beaked Willow

Heart Leaved Willow.

Probably the Goat (*Salix caprea*), the Weeping (*S. babylonica*), the Black (*S. nigra*), the White (*S. alba*), and the Long Beaked (*S. rostrata*) are among the more distinctive and better known willows.

The goat willow is frequently seen in lawns. It furnishes the foundation for the weeping umbrella-like tree called Kilmarnock Willow. The catkins appear long before the roundish leaves, and, in ripening, show better than any other "pussies" either the yellow stamens, or the two-horned pistils, of which they are composed.

The wood of the willow makes the best of charcoal, and is used in medicine; but it finds its greatest commercial value in the manufacture of wicker work.

THE OAKS:

> "The monarch Oak, the patriarch of trees,
> Shoots rising up, and spreads by slow degrees:
> Three centuries he grows, and three he stays
> Supreme in state, and in three more decays."

Oak.

Both the ancient inhabitants of Greece and of Britain worshipped the oak; and in all ages, among all people, the majesty and beauty of the tree has made it the glory of the woods and the recipient of the admiration of men.

Its fruit, the acorn, was an important article of food to the early inhabitants of Europe, and is still sold for that purpose in parts of Asia Minor and Spain. In our own country, the bear, the raccoon, the squirrel, the wood pigeon, and the swine fatten on them. The bark is used for dyeing and tanning. The bark of the Spanish cork oak gives us cork. But the most valuable product of all is the wood, which for strength, hardness, and durability is unsurpassed.

There are still standing in England oaks known to be from a thousand to twelve hundred years old.

In an old oak in Boscobel Forest, King Charles II. remained successfully concealed for a day after the battle of Worcester, from which circumstance the oak became a Stuart emblem. The day of accession of

Chestnut Oak.

White Oak.

Pin Oak.

Black Oak.

Charles was long celebrated as a holiday, under the name of Royal Oak Day.

The Yule log, half burnt at each of the great feasts of the Druids, was of oak.

Red Oak.

a, Acorns, first year; *c*, Acorns, second year.

The Round Table of King Arthur, still shown at Winchester, alleged to be genuine, is a cross-section of an old oak tree, eighteen feet in diameter.

The Greeks believed it to be the first tree that grew on

earth, and the Greeks, Romans, and Germans considered it sacred to the king of the gods, called by them, respectively, Zeus, Jupiter, Thor.

A chaplet of oak leaves was the highest honor that could be given to a Roman soldier.

Next to the Charter Oak, perhaps the most famous American oak is the one near Fishkill, on the Hudson, under which, it is said, Washington used to mount his horse. Even then it was famous for its age.

In the Middle Atlantic States, of the trees that ripen their acorns within a year, the best known are the white and chestnut oaks; within two years, the black, red, and the pin oaks.

The oak is peculiarly subject to the attacks of insects. Several different species produce on them various galls, or large swollen masses, caused by irritation of the plant tissue, and in the centres of which are the eggs of the gall insect. From a tincture made from boiling certain kinds of these, on the addition of copperas, ink is made.


Beech.

THE BEECH:

The bark of the beech, a favorite subject with painters, is a smooth bluish gray, sprinkled with round ash-colored spots. The tree often retains its yellow withered leaf all winter. These facts, combined with its peculiar bowl shape, especially marked in the

young tree, and the long, spindle-shaped pointed buds, make it easily recognizable even in winter.

The Copper Beech, closely related, if not identical, to our own, made up those Birnam woods, whose approach was to foretell the death of Macbeth.

The CHESTNUT has been already fully described. See pp. 71–73.

Buttonwood, leaf and ball.

THE BUTTONWOOD OR SYCAMORE (Platanus Occidentalis):

This is the largest and loftiest of all our native trees. Its broad spreading branches and large leaves form a

dense foliage for which it is chiefly esteemed, no part of it being of any particular commercial value.

No tree is easier to identify. Its leaves, bark, flowers, fruits, all are characteristic.

In spring the new shoots and leaves are covered with a copious down, which is gradually shed during the first season, except from the under side of the leaves and at the joints of the stem.

The pistillate flowers make a globular ball, five-eighths of an inch in diameter. This afterwards forms the button-ball, or fruit cluster, which often swings on the tree by its long slender stem the greater part of the winter. The staminate flowers are on a slender thread, one or two inches in length.

The brown gray bark of the buttonwood peels off each year in thin, broad, brittle pieces, showing the light buff, fresh bark beneath.

The sycamores, still standing, celebrated by Whittier in his poem of that name, were planted by the Merrimac, where now stands the town of Haverhill, nearly a hundred and twenty years ago. Under their shade passed Washington in his triumphal journey to the North in 1789, and it was underneath them that Whittier planned out his poem of Skipper Ireson's Ride.

The Oriental Sycamore, often planted in our parks and closely resembling the buttonwood, was a great favorite with all European nations; from the Greeks and the Romans, who are said to have nourished it with pure wine, to the Italians, Spaniards, and French, who, in early times, were compelled to pay for the privilege of sitting beneath its shade.

It is said that the famous general, Xerxes, was so delighted with a beautiful tree of this kind that grew in

AILANTHUS (Ailanthus glandulosus):

The only objection to this tree is the fact that the staminate flowers which appear in June are offensive in their odor. There is, unfortunately, no way of telling whether a tree will bear stamens or pistils until it has grown up. It is said that of a large lot of trees from

Ailanthus, branch, under side of leaf showing the glands of the leaflets.

the same stock, planted at the same time, those in New York turned to be pistillate, while in Philadelphia all of the trees bore the ill-smelling sterile flowers. It is a rapidly growing, easily propagated, graceful tree with pinkish or pale-green winged seeds. In China it is called the Tree of Heaven. The handsome ailanthus still standing in Bartram's Gardens, Philadelphia, was planted in 1809 from a sucker of the first tree brought into this country.

Locusts:

The Common Locust (*Robina Pseudacacia*) and the Honey Locust (*Gleditschia triacanthos*) are frequently found, even in city streets.

The wood of the locust has considerable commercial value. The heart of the tree is liable to the attacks of insects so that it is very seldom that one sees a tree without a dead or dying limb, although the leaves seem to be singularly exempt from diseases of all kinds.


Locust, leaf and flower clusters.

As the structure of the fragrant, beautiful flowers and of the fruit plainly shows, the locusts belong to the Leguminosæ, or Pea family.

The honey locust is so called from the greenish yellow sweet pulp which fills the space in the pods between the seeds. This is much relished by children, who, however, wait until the fruit drops, not venturing to climb a tree so well protected with its numerous clusters of triple thorns.

The seeds are very hard, brown, and shiny. Children call them "burning stones," rubbing them to make them hot.

The leaves are bipinnately compound, but it is not unusual to find every transition back to the parent type of a once pinnately compound leaf.

green, delicately lined with bronze, a leaf somewhat resembling that of the sugar maple, and fruit with widely divergent wings; the sycamore maple (*A. pseudoplatanus*), called in England the sycamore, with its green inconspicuous flowers, oddly winged fruit, and rather-sycamore-like leaf.


Sycamore Maple.

The Sugar or Rock Maple (*A. saccharinum*) deserves a paragraph to itself. Its wood is very hard, and extensively used in cabinet work. The most beautiful form which it takes, called, from obvious resemblances, bird's-eye maple and curly maple, is caused by rather rare conditions, in which the wood vessels become twisted or deflected from their naturally straight course.


Red Maple.

The sugar maple should not be tapped before it is twenty-five years old, but the process may be repeated annually without apparent injury to the tree. Open winters are supposed to make the sweetest sugar, and much freezing and thawing to be necessary to the abundant production of its best quality. The sap season con-

Sugar Maple.

tinues for six weeks, but in this time there may not be more than fifteen really good sap days. These are clear bright days, with a westerly wind and frosty nights.

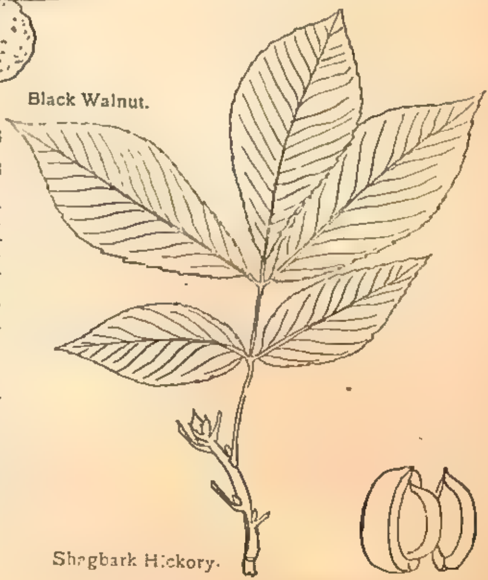
The farmer taps the tree with a three-quarter-inch auger, and into the hole thus made puts an iron or wooden spout, from which is suspended the pail. This receives the sweet sap, which flows at the rate of about seventy drops per minute when it runs most rapidly. The usual amount of sap given by a tree in a season is twenty-five gallons, which yields about five pounds of sugar. Formerly, the sap was boiled in long pans over a bricked-in log fire, but nowadays it is put in one end of a patent evaporating machine as sap, and comes out at the other as syrup.

The tree itself is very large and much handsomer than the common locust.

Black Walnut.

THE WALNUTS AND HICKORIES:

These trees are closely related, botanically and economically. Both are lofty timber trees, with aromatic, compound-pinnate leaves; fruits whose covering is used for dyeing and whose sweet and wholesome kernel abounds in oil. Their wood is very valuable.



Shagbark Hickory.

The ASH is second in the value of its timber only to the oak, which it resembles in the grain of its

wood. The fruits are particularly interesting from their modifications for wind distribution.

Horse-chestnuts and Buckeyes:

Many of the details of the horse-chestnut have been given under the buds in the previous chapter.

In general the buckeyes may be distinguished from the horse-chestnut by the fact that their leaves have only five leaflets, instead of seven, and are much less woolly in the bud.


Black Ash.

The names, Hyacinth Tree and Giant's Nosegay, very well express its stately and beautiful effect in the spring, when its erect clusters of flowers bloom forth from their dark green ground, like burning lamps on a huge chandelier. In London, the blooming of the horse-chestnut is announced in the papers, and crowds of people go out to Bushey Park, Hampton Court (Wolsey's old palace), to see its avenues of magnificent trees.

Very few of the flowers ripen into fruit, which is a large prickly ball of green. It splits open into three chambers, each of which should contain a seed; but as in the case of the sweet chestnut, often one or two of them grow at the expense of the others.

Method :

The best way to study the trees is, without doubt, by making numerous short excursions, for which the children have been prepared, and to which they go armed

Horse-chestnut.

with note-books and pencils to search for definite information.

Usually I have drawn or shown the leaf, teaching its name. Then after showing the children the importance of indicating correctly the height of the tree, the height

of its trunk above ground, and its general outline, I sent them out to draw the tree as a whole. I also required them to make a note, at the same time, of the color and character of the bark, and any other distinctive features.

These points were then discussed in school, and later, drawings made of the leaves, or flowers, or sometimes of branches. These may be gathered fresh each year, as indicated below, or better still, the first supply may be pressed, mounted on cards, and used year after year. The secret of pressing so as to preserve the color is to choose young leaves in June, or earlier, and to dry them rapidly by changing the driers, or newspapers, every day, or oftener for the first few days.

To mount them securely, use plenty of fish-glue, pressing each part carefully down.

After studying a number of trees, the children may make a plan of the locality, marking the names of the various trees there found, labelling each by drawing below it the leaf.

A reproduction of one of these plans just as it was handed in by the pupil will be found in the Appendix.

In addition to the numerous excursions, the talks on the uses of the trees, and the drawing lessons, the teacher may also make use of the language and literature lessons, to serve not only their own purposes, but also to make each tree a living reality to the child.

For the benefit of those who think that they cannot manage the excursions, I submit the following plan: Gather four or five times as many leaves as there are children, sprinkle them slightly, roll them up in a strip of old cotton or other thin cloth, and place them in a tight tin box, or covered jar.

For the first lesson direct their observation by asking

questions which they must answer silently, such as the following: How many parts are there? What is the color of each part? Describe with one word the surface. Turn the leaf over; what do you observe with reference to the color and the surface of the under side? Look at the margin of the leaf. Make a drawing of the upper and also of the lower surface, indicating with words anything additional you may have observed. Collect drawings.

For the second lesson, place on the board outline drawings of the leaf studied. Teach the terms "blade," "leaf stalk," "veins." Erase drawings and words, give out fresh leaves, and conduct an oral language lesson on the points to which their observation was directed the first day. Have them taste the leaf, first the stalk, then the blade. Ask if it has any odor. If not, let them suggest that crushing and bruising will bring out whatever perfume it may have. Guard them against the rather dangerous practice of tasting everything within reach. Give out paper. Ask them to make other drawings, naming the parts, adding to it in words whatever they cannot show with the pencil. Afterwards allow them to compare the first work with the second.

Give to each child a small note-book. These may be purchased in quantities for a cent each. To each attach securely a pencil. On the first page let each make a map of the route from his home to the school. Give to each child another leaf, and ask him to put in his plan every tree bearing these leaves which he sees on the way home. Send him a second time, to find out which of these is the most beautiful, and why. Let this be his tree, and let him gradually learn all that he can

about it: its height, breadth, and general shape; the height above the ground at which it begins to branch; the direction taken by the branches; the bark; the arrangement of the branches, the arrangement of the leaves, the buds, and, if possible, the flower, fruit, and wood.

LITERATURE

Myths and Stories:

Apollo and Daphne.
Baucis and Philemon.
Pan and Apollo.
The Vine and the Oak, Emerson's Indian Myths.
Old Piper and the Piper of the Dryad, Frank Stockton.
The Walnut Tree that Wanted to Bear Tulips, Wiltse's Stories.
Last Dream of the Old Oak, Andersen.
Legend of the Poplar, Marah Pratt's Fairy Land of Flowers.
Oak and the Ivy, Eugene Field.

Poems:

The Birch Tree,
The Oak,
The Beggar,
Rhoecus,
The Maple, } Lowell.
Hiawatha's Canoe, Longfellow.
Planting of the Apple Tree,
Forest Hymn, } Bryant.
The Tree, Björnsen.
The Tree, Jones Very.

THE EARLY SPRING FLOWERS:

Of these, the following, all of which may be easily obtained, even in the city, should certainly be taught in every classroom:

Spring Beauty (*Claytonia Virginica*), the Trailing Arbutus (*Epigæa repens*), the Common Blue Violet (*Viola*

cucullata), the Quaker Lady (*Houstonia cærulea*), and the Cherry Blossom.

If it is possible to get the material, the children should know, at least by name, the hepatica, bloodroot, the anemones, and the dogtooth violet.

THE SPRING BEAUTY: This, like all of the other early spring flowers, has nourishment ready to be turned into available food, just as soon as a little warm rain furnishes a first cause and means.

Spring Beauty.

In this case the starch is stored in a small, deep tuber from which comes the root.

The number and peculiarities of the leaves, the structure of the flowers, and of the flower clusters are easily made out. The stamens ripen before the pistils, so that we do not find the stigma three cleft until the stamens have discharged their pollen. This means, of course, that the ovules must be fertilized by pollen from other flowers.

It received its botanical name (*Claytonia Virginica*) from John Clayton, who established in Virginia the first botanical garden in America.

To the same family belong portulacca and the pusley, hated by the gardeners because of the trouble that it gives in weeding it out.

Trailing Arbutus: The fragrance of the flower at once betrays both to the insect and the botanist the store of honey within. The inside of the corolla is densely covered with fine, soft hairs, which serve to close its tube, perhaps from the rain that would dilute the honey, or, perhaps, from unwelcome visitors who would pilfer from the flower its sweets, giving nothing in return.

On examining a number of different clusters, it will be noticed that the smaller, less widely opened flowers are the only ones which have the five long branches to the stigma which make it look like a little star, and that in these flowers the stamens are apt to be short and without anthers. In the flowers in which the stigmas are short the stamens are well developed. This looks as if the flowers were actually becoming unisexual, since, if it continues on the road on which it has plainly started, there will, eventually, be flowers with pistils only, and other flowers with only stamens.

It is one of the plants which has never been successfully transplanted. For this reason botanists have tried, but failed, to find a trace of parasitic root connection.

It belongs to the Heath family, in which are also found the azalea, rhododendron, blueberry, huckleberry, wintergreen, and mountain laurel.

Common Blue Violet: The flowers of the violet have all of them something of the same markings that are to be found in their cultivated cousin, the pansy. These all lead to the spur, and are followed by insects in search of honey. But there is very little nectar in the early violet, although it is quite abundant in the pansy.

The appendages of the two lower stamens project into

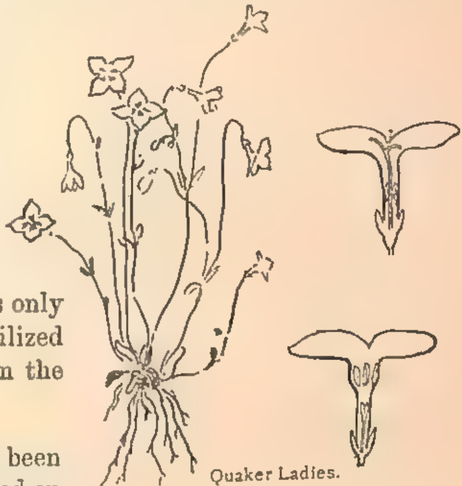
the spur, and secrete the honey. In getting at this, the bee thrusts the anthers apart. These, thereupon, deposit on him some of their pollen. This cannot be left on the pistil, because of the lip (which will be evident to any one who examines it carefully), but it is left in the stigmatic cavity of the next flower to which it goes.

Common Blue Violet.

Strange to say, the greater portion of the good seed of the violet is not produced in the flowers thus elaborately cross-fertilized, but in underground flowers, which look like small green buds, and which never open.

QUAKER LADIES: These pretty little flowers, also called bluets, innocence, blue-eyed babies, bright eyes, are always great favorites with children.

It will be noticed that the larger flowers have in the cup an obviously two-branched stigma, while in the smaller flower the four stamens are much more evident. Quaker ladies, in truth, are the first, while the latter might be called Quaker gentlemen, for the long-styled flowers only set seed when fertilized by the pollen from the long stamens.



Quaker Ladies.
Flower with long pistil; flower with short pistil.

The Cherry has been sufficiently described on p. 172.

HEPATICA: This is one of the earliest and most attractive of the spring flowers. The furry flower buds open before the leaves, although there are always numbers of last year's leaves to be found. The colors of the flowers vary greatly, and in accordance, mostly, with their situation with reference to the sunlight, although it is by no means uncommon to find pink, blue, and white flowers on the same plant. Strictly speaking, there is no corolla, the calyx taking its place, while what seems to be a calyx, the three leaves at the base of the flowers, is really an involucre.

Bloodroot: Secure, if you can, the whole plant, showing the thick root stock with this year's plant, and the bud for the next. Particularly beautiful is the development of the leaf, which is rolled round the flower bud. The calyx, made up of two sepals, soon drops off.

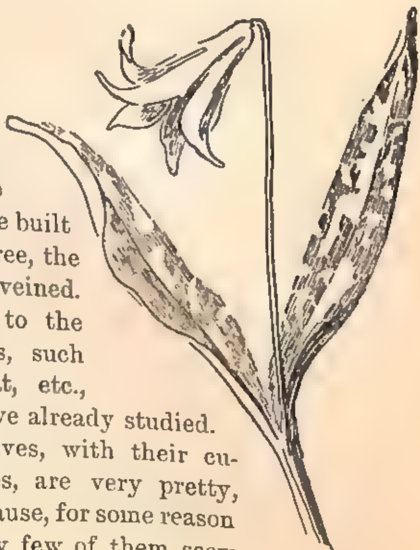
Bloodroot.

The reason for its popular name is very evident to one who handles any part of the plant.

To the same family belong also the poppies.

Dogtooth Violet: This is not a relative of any of the violets, but belongs to the Lilies. The flowers are built up on the plan of three, the leaves are parallel veined. Therefore it belongs to the one-seed-leaved plants, such as grass, corn, wheat, etc., which the children have already studied.

The plants themselves, with their curiously spotted leaves, are very pretty, which is fortunate, because, for some reason or other, comparatively few of them seem ever to flower.



Dogtooth Violet.

Methods:

Make a point always of the fact that these flowers bloom early because of the abundant supply of nourishment ready for their use, stored up by the plant the year before.

The general method for the study of flowers in general is sufficiently treated on p. 22 *et seq.*

LITERATURE

Myths and Stories:

Little Ida's Flowers, Andersen.
Legends of the Arbutus, } Emerson's Indian Myths.
Legend of the Spring Beauty, }

Easy Poems:

The Little Flower Came from the Ground, } Eleanor Smith's Songs for Little Children.
The Flower Bed, }

Plant Household, } Emilie Poulsson's In the Child's World.
Little Plant, }
Calling the Violet, Lucy Larcom.

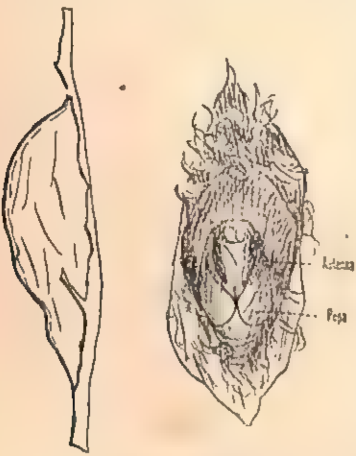
More Difficult Poems:

The Voice of the Grass, Mary Howitt.
The Grass, Emily Dickinson.
Jack-in-the-pulpit, Whittier's Child Life.
Violet, Barry Cornwall.
Yellow Violet, Bryant.
The First Flower, }
Trailing Arbutus, } Whittier.
May Flower, }
A Laughing Chorus, } Lovejoy's Nature in Verse.
The Violet, J. Taylor, }
The Daffodils, Wordsworth.
The Daffodils, Herrick.

ANIMALS

The necessary facts with reference to the animals to be studied this month — moths, butterflies, beetles, bees — have already been given in the first chapter.

In the fall the adult insects and larval forms, whether caterpillars or grubs, going into winter quarters were studied. Now these winter quarters and the emerging adult form should be given the chief consideration.



Cecropia cocoon. Cocoon cut open.

The best material for this purpose is the large Cecropia cocoon. This may be cut open after the moth emerges. The outside covering is plainly impervious to moisture. Within, it is a loose mass of silk, beyond which is another coat like the first. Inside of this there still remains the cast-off skin of the caterpillar and pupa, within which took place all the marvellous changes through which a wormlike creature was transformed into one of our most beautiful moths.

The two sexes of the Cecropias may be easily distinguished one from the other by the size of the antennæ, which, in the case of the male, are very broad and feathery.

They live at the best not much longer than three weeks, during which time they eat nothing. They mate freely, even in confinement. The large light eggs hatch into

tiny caterpillars, which should be kept in a moist cage with plenty of fresh maple leaves for food. This caterpillar, however, is much less discriminating in his choice of food than many of his relatives, and will eat a great many different kinds of leaves.

It is comparatively easy to raise broods of caterpillars, if they can be safely guided beyond the first moult. Moisture and abundant food are the two chief requisites.

CHAPTER IX

MAY AND JUNE

Easy Poems:

May,
Signs of May, } Lovejoy's Nature in Verse.

More Difficult Poems:

Extract from Lowell's Under the Willows.
May, Celia Thaxter.

PLANTS

In May and June should be continued the study of the trees already described in Chap. VIII.

The children should also learn to distinguish between ferns, mosses, lichens, and toadstools, and something of the structure of each.

The following flowering plants should be studied: Dandelion, daisy, apple, strawberry, buttercup, and clover. If it is desired to add to this number, take jack-in-the-pulpit, shepherd's purse, chickweed, or sheep's sorrel. These are suggested not because of their greater interest, but because of the fact that except the first, children will find them growing even in city streets.

The Dandelion (Taraxacum officinale).

Facts:

The dandelion has a very thick tap root, which, like the rest of the plant, is full of milky juice. The leaves

are long, sessile, and coarsely toothed. When it grows in good soil and in grass, its leaves reach upwards; but in barren soil they spread out over the ground in the form of a rosette, thus pre-empting the greatest possible amount of land to its own use, and suffering thereby no loss of necessary light, since there are no other plants to shade it.

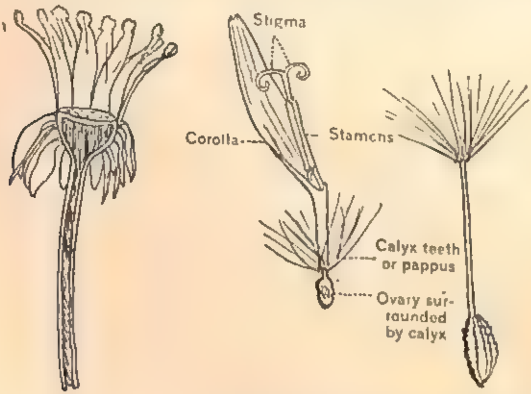
It belongs evidently to the Composites (see p. 24 *et seq.*).

Dandelion.

Its flowers are all strap-shaped. Like all of the other members of this order, they are adapted to cross-fertilization by insects; yet close fertilization is possible, since the branches of the style bend backwards until they make a spiral, thus exposing the inside stigmatic surface, which is the only part of the pistil on which the pollen will send out its tube. Some arrangement like this is necessary, since the dandelion begins to bloom before the insects are active, and continues in blossom long after they have disappeared.

The pappus (calyx teeth) is carried up above the ovary in the fruit, thus making a balloon easily blown about by the wind.

The involucre not only protects the flowrets in the bud, but at night, or during a rain, closes around them. It performs the same office for the ripening fruits, which are often further protected by the bending downwards of the stem. When they are fully ripe, this rises again,



Dandelion, cross section of receptacle surrounded by involucral leaves, flower, fruit.

thus aiding in the distribution of the fruits. What wonder that a plant so marvellously protected during its whole history, and with so many efficient devices for the wide distribution of its fruits, should be one of our commonest weeds!

Daisy (Chrysanthemum leucanthemum):

This plant belongs to the Composites also, but, unlike the dandelion, has both disk and ray flowers. The ray flowers have no stamens. Perhaps for this reason, in

compensation, the corolla is larger. These flowers serve not only to render the daisy more conspicuous, but also protect the fertile disk flowers in the bud and at night.

The daisy is easily propagated from the root. This makes it very difficult to get rid of, since the spade only increases the number of plants.

It is detested by the farmer, to whose fields it does a great deal of harm by almost exterminating the more valuable grass crop.

Method:

The points given on p. 238 *et seq.* should be made clear. Teach the whole plant, as well as the flowers, making use of blackboard or hektograph drawings.

At least two lessons should be devoted to the dandelion.

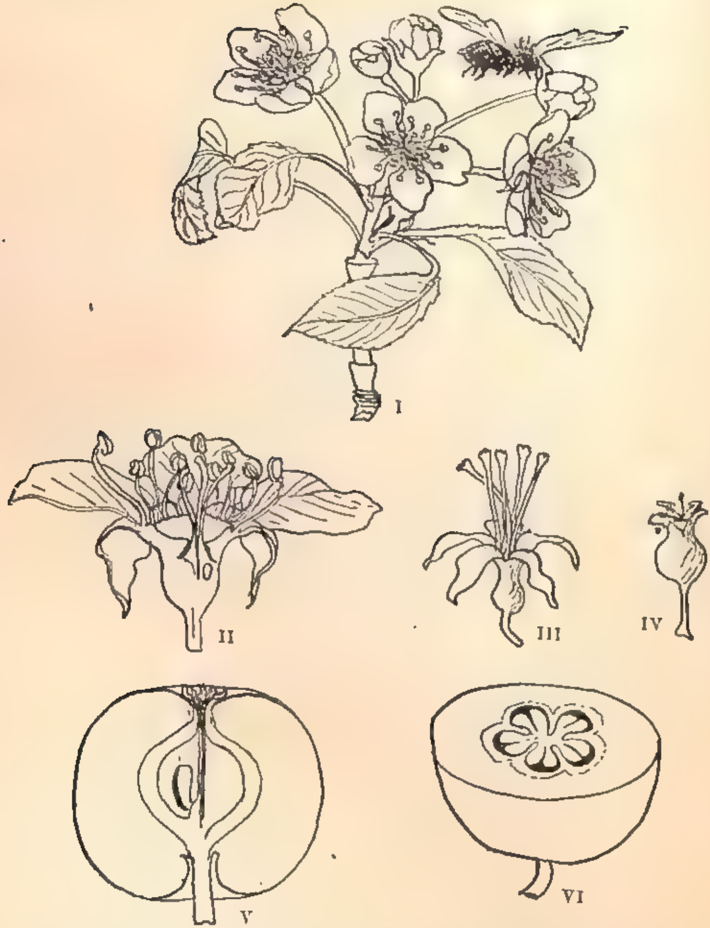
Apple.

Facts:

Like the Cherry, the numerous stamens are inserted with the petals on the throat of the calyx. The base of the calyx, however, is united with the base of the pistil, or ovary (seed box), which has five cells with two ovules in each cell.

The odor and beauty of the flower indicate the presence of nectar to the botanist and the bee. It is very abundant.

After fertilization takes place, the petals and stamens fall off, and the whole energy of the flower is devoted to the making of the fruit. The walls of the ovary thicken somewhat, but the greatest change takes place in that part of the calyx which is adherent to the ovary. It finally makes up the greater portion of the flesh of the apple. The five lobes of the calyx, with the five branches

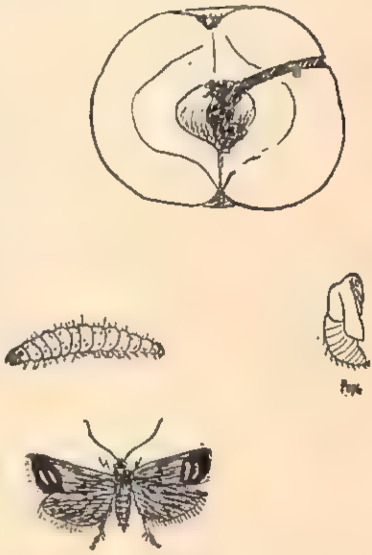


The Apple: I. Blossoms and leaves. II. Vertical section of the flower, showing pistil, stamens, petals, sepals. III. Flower after the petals have fallen. IV. Small green apple. V. Section of apple, showing the eye (pistil and calyx tips), thickened ovary (core), and thickened calyx. VI. Cross section of the same.

of the pistil carried upward, together constitute the eye of the apple.

A cross section of the apple shows the ten-seeded, five-celled ovary separated from the thickened calyx by a green line. In vertical section this separation of ovary and calyx is demonstrated more clearly still.

The green of the apple changes into more brilliant colors as the sun ripens it, thus making it attractive to the small boy and other animals, who, in return for the pleasure that it gives them, uncousoiously aid in the distribution of its seed. These, protected by their hard, shiny coats, easily survive both the damp and cold.



Work of the Codlin Worm. Larva. Pupa. Codlin Moth.

Method:

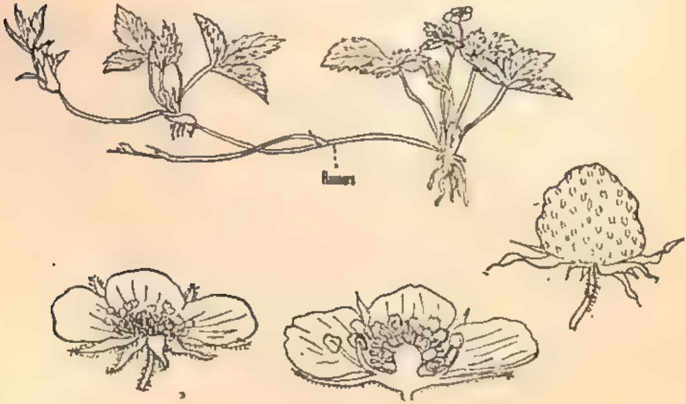
Teach the blossoms in season, pursuing the same method indicated on p. 22 *et seq.* for other flowers. Later use the small green apples, together with cross and longitudinal sections through ripe apples, to make clear this most interesting story.

Lay emphasis on the law of compensation, here shown in the fall of the petals and consequent devotion of the energies of the plant to the manufacture of fruit.

STRAWBERRY.

Facts:

This belongs to the same family (the Rose) as the apple and cherry. Like them, the petals and numerous stamens are inserted on the throat of the calyx, which in this case consists of ten lobes (apparently), and is entirely free from the very numerous one-ovuled pistils, which form a head on a large receptacle.



Strawberry.

After the petals and stamens fall, the juices of the plant feed the receptacle, which becomes fleshy and, as it ripens, usually red in color, bearing all over its surface the numerous yellow fruits. These are widely distributed by the birds and other animals, who devour the so-called berry, but through whose alimentary tract the real fruits pass undigested.

As a matter of fact, however, the strawberry is propagated by runners,—long, slender stems which root at a

distance from the parent plant, thus forming new individuals.

To the Rose family, besides the three already mentioned and the rose itself, belong the following common plants: pear, quince, peach, plum, fivefinger, shadbush, hawthorn, blackberry, and raspberry.

Buttercup.

Buttercup (Ranunculus bulbosus):

This belongs to the same family as the hepatica and anemones. The name of the family — Crowfoot — perhaps refers to the shape of the leaves, which are often much cut.

The common buttercup has a bulb, which is enveloped by the dilated base of the root leaves. These are palmately compound, with three much-cut divisions, or a long leaf stalk or petiole. The stem leaves, on the contrary, are sessile.

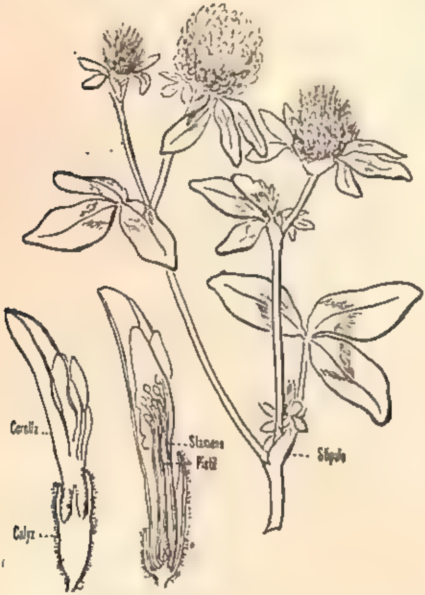
All of the parts of the flower are present and free from each other. The sepals frequently drop off before the rest of the flower has faded at all.

Notice at the base of each petal the small nectar scale.

The outermost stamens ripen and discharge their pollen first, even while the inner stamens are still covering over and protecting the young pistils. These are similar in kind and arrangement to those of the strawberry.

Clover (Trifolium pratense):

The flowers of the common red clover are so thickly clustered in a head, that for a moment one might think that it belonged to the Composites. A very slight examination of the single flowers shows that it belongs to the Pea family.


Red Clover, buds and blossom.

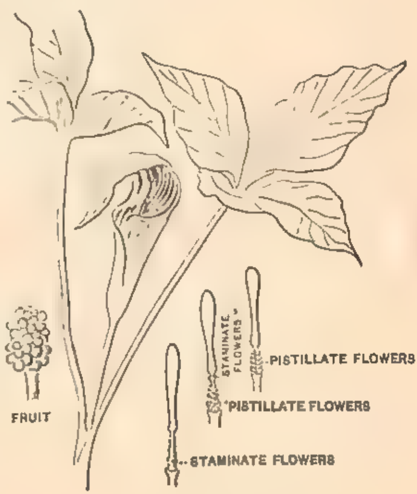
As in the other members of this family, the stipules, or leaf-like bodies at the base of the leaf stalks, are very conspicuous.

The calyx has long, bristle-like teeth. The tube of the characteristically butterfly-like (papilionaceous) corolla is very long, so that it can only be fertilized by long-tongued insects, such as the bumble bee. Our honey bee, however, gets round the difficulty most ingeniously by biting the tube. It is well worth his while to take this trouble, for the nectar is very abundant.

When the red clover was first imported to Australia, it failed to set seed, because of the absence of insects with tongues sufficiently long to fertilize it. This difficulty was finally obviated by importing bumble bees.

Doubtless most people have heard of Darwin's illustration of the remote causes determining animal or plant existence, as illustrated by the relationship of cats to clover. He says that the bumble bees, which are necessary to the fertilization of the flower, have, for an invetерate foe, field mice. These, in turn, are preyed upon by the cats. Therefore in any given community the presence or absence of cats determines the presence or absence of clover. Or, as some one facetiously puts it, for the well-being of clover there must be plenty of old maids.

White clover is also commonly found. It does not differ materially from the red, except that the tube of the corolla is short, and therefore it is frequented by a larger variety of insects.



Jack-in-the-pulpit.

JACK-IN-THE-PULPIT (Arisæma triphyllum):

In spite of the fact that the leaves of this plant are netted veined, it belongs to the one-seed-leaved plants (monocotyledons). It is a near relative of the skunk cabbage, the earliest flower to bloom in the spring, and of the stately calla. Like them, its real flowers are situated inside the showy envelope, and, in this case, at the

base of the rather thick spike called spadix. The term "spathe" is applied to the envelope. Of course, the spadix is the Jack who preaches from the spathe pulpit.

Some of the Jacks are green, striped with darker lines of the same color; others are striped with purple. In England, the latter are called the lords, and the lighter ones, the ladies. As a general rule, however, the lords are ladies, botanically speaking, since they commonly contain the pistillate flowers.

Sometimes Jacks will be found on whose spadix are both staminate and pistillate flowers, in which case those containing stamens only are above those with the pistils.

The part of the Jack-in-the-pulpit underground is thick and fleshy, very acrid in taste, and supposed to be poisonous. Long boiling makes it eatable. Hence it is often called Indian turnip.

Shepherd's Purse.

SHEPHERD'S PURSE (Capsella Bursa-pastoris):

This belongs to the Mustard family, whose members are recognized almost at a glance, since their corolla forms a Greek cross, and, of their six stamens four are long and two short.

The curious seed pods furnish the reason for both the botanical and the common name.

Chickweed (Stellaria media):

The flowers of this plant are much too small for children to examine. The most that can be done is to let them see, that instead of ten petals, as there appear to be at first sight, there are really only five.

It belongs to the Pink family, and is very common in moist ground, both in the city and the country.

Sheep's Sorrel (Rumex Acetosella):

Sheep's Sorrel.

This plant has no relationship to the pretty yellow sorrel, although it bears the same name. The leaves of both are pleasantly acid.

Along with the Smartweeds, also very common, it belongs to the Buckwheat family.

Its flowers and fruits make the meadows red in summer.

Ferns:

These have already been discussed on p. 36.

Mosses:

One of the most striking characteristics of the mosses, particularly in comparison with the higher plants, is the quickness with which they succumb to drouth, and with which they recover from its effects when they are furnished with moisture. This is due to the fact that they readily absorb water in any and every part. and do not depend exclusively on their so-called roots, which are chiefly useful in securing a hold on the soil.

Few plants can resist so successfully the effects of heat and cold, drouth and moisture, and by reason of this they are universally distributed. There is no spot so barren and desolate that some kind of moss or lichen may not be found near by.

Like the ferns, they have no flower, but reproduce by means of spores instead of seeds. These spores are con-

Moss Plant, lid and cap removed, showing spores within.

tained in capsules borne, in all of our common mosses, on rather long stalks, and additionally protected by a curious sheath, which resembles the cap of a Normandy peasant or, sometimes, a candle extinguisher.

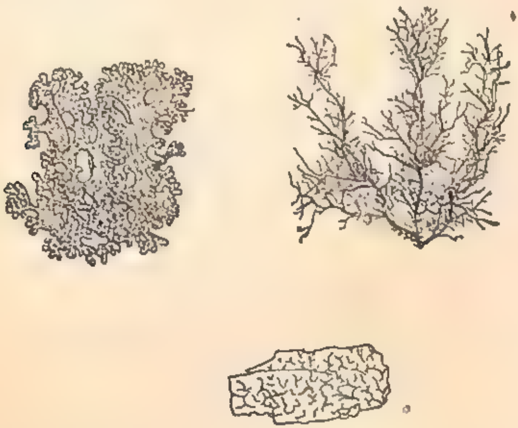
Peat, burned by the Irish peasant, is almost entirely composed of moss. One species is used by the Laplanders to line their cradles, and another by the Esquimaux for lampwicks; but their greatest use to man is the

indirect one of furnishing soil and protecting other plants against the effects of the great heat or cold.

LICHENS:

These are the grayish mosslike plants found growing everywhere, on fences, trees, stones.

The so-called reindeer moss is a lichen, found also very commonly here, on stones or on the ground, gray and much branched.



Three common types of Lichens.

In reality, a lichen is a partnership formed between a colorless fungi and a green water plant, or algæ, by which they live together amicably, each helping the other.

FUNGI:

To this class belong plants destitute of green coloring matter, living on dead or dying organic substance, and, in consequence, unlike all other plants, perfectly independent of light.

They are very numerous, both as species and as individuals; perhaps the common toadstool or mushroom is the most likely to be attractive and interesting to children.

The vegetative organs are quantities of white interlacing threads, which penetrate and ramify the decaying substance on which the mushroom grows. This is the spawn from which the mushroom is propagated by supplying the necessary moisture and heat. There is first produced a round fleshy tubercle, from which is developed a stalk surmounted by a round cap, which is covered with a veil. This soon breaks, leaving always a reminder of its former existence and position, in the shape of the ring around the stalk. When it is torn away, there is disclosed underneath the cap many vertical leaves or gills which bear numberless spores, by which the parent plant is again reproduced.

Story of the Mushroom.

These plants grow with great rapidity, and the force generated in consequence is most astonishing.

It is related that a fungus, placed within a glass vessel, expanded so rapidly that the dish was broken into pieces with a noise as loud as the report of a pistol.

Another famous story is of a paving stone, twenty-one inches square, weighing eighty-three pounds, raised an inch and a half from its bed by a mass of toadstools, six or seven inches in diameter.

LITERATURE

Stories:

Legend of the Daisy, Ranunculus (Buttercup), Four Leaf Clover, } Baumbach's Summer Legends.

These Three (Moss), Mrs. Gatty's Parables from Nature.

Dandelion Clocks, Mrs. Ewing.

The Dandelion, Longfellow's Hiawatha.

Daisy, Pea Blossom, } Andersen.

The Sleeping Apple, How West Wind Helped Dandelion, } Emilie Poulsson's In the Child's World.

St. Elizabeth and the Roses, Baby Calla, } Wiltse's Kindergarten Stories.

Easy Poems:

Buttercups and Daisies, Mary Howitt.

Dandelion Fashions, Songs for Little Children.

Stars and Daisies, Eleanor Smith.

Little Dandelion, Whittier's Child Life.

Dandelion, Apple Blossoms, Wake up, Little Daisy, The Lilac, Chorus of the Flowers, } Lovejoy's Nature in Verse.

Dandelion's Complaint, St. Nicholas, August 1897.

Dandelion, St. Nicholas Songs.

More Difficult Poems:

Winged Seeds (Dandelion and Maples), Lovejoy's Nature in Verse.

Jack in the Pulpit, Whittier's Child Life.

Daisy, Montgomery.

Seven Times Four, Jean Ingelow.

Song of Clover, Saxe Holme.

Dandelion, Lowell.

Dandelion, Tabb.

STONES

It is rather difficult to say what stones will be brought in by the children. But the teacher will certainly need to know something about limestones, sandstones, and slates.

The safest plan with stones, is to take the specimen to a specialist, and then, with the name as a clew and the specimen in your hand, learn all that you can about it both from books and people.

Limestones:

The best-known limestone is marble, which is found in nearly every color, — white, yellow, red, blue, black, — but is most familiar to us as the white marble so extensively used for entire buildings, doorsteps, mantels, table tops, and tombstones.

A piece of marble tested with the knife and with dilute acid, strong vinegar, or weak hydrochloric acid will be proved to be a soft rock made up of carbonate of lime. The acid combines with the lime, setting free the carbon dioxide, which causes the effervescence.

The carbon dioxide, thus produced from marble and acid, is identical both in nature and method of manufacture with the carbon dioxide which gives the agreeable pungency to soda water.

It is identical, also, with the carbon dioxide exhaled by plants and animals, which, while it is not an active poison, produces death by suffocation, since its presence means the absence of oxygen.

In this connection read the story of the Black Hole of Calcutta so graphically told by Macaulay.

Marble is distinctly crystalline in structure, a change brought about in its metamorphosis from ordinary limestone by the combined action of pressure and heat.

Its softness and effervescence with dilute acid is the test for all of the limestones.

The other well-known forms are the ordinary gray limestone and chalk, not the chalk of the schoolroom, which is a paste made up for the most part of sulphate of lime, but the chalk of the White Cliffs of Dover.

Limestones are all originally aqueous and organic in origin. This is clearly visible to the naked eye in what are know as shelly, coral, and crinoidal limestones. The Coquina stone, now forming along the Florida coast, consisting of coarse shell fragments held together with natural cement of lime, tells plainly the story of its formation.

SANDSTONES:

Sandstone may be of almost any color, but it is most familiar to us in the city as "brown stone" and "gray stone." It is granular, hard, gritty, and does not effervesce with acids, except the kinds that happen to have a carbonate of lime cement holding the grains together. These last are soft sandstones.

Brown and red sandstones have a cement of iron, while most of the light sandstones are cemented with silica, which makes, of course, a very hard rock.

All of the sandstones are of aqueous origin. The stratification is not always visible, but the shape and kind of grains are sufficient indications. Moreover, they often contain fossils.

The conglomerates, of which the pudding stone is an example, belong to the same family of rocks. They are

made up of pebbles instead of the smaller grains of sand.

Slates and Shales:

These are simply compressed clay, and can be easily recognized by the characteristic odor obtained by moistening them slightly.

They are of aqueous origin, and in consequence often contain fossils. Sometimes ripple marks and the impress of raindrops are to be seen.

Their principal commercial use is for blackboards, slates, roofing, flagging, tiles.

Method:

None of these families of stones should be taught, unless the children themselves furnish the pretext by bringing in the specimens.

Aside from the observation and tests to which, by this time, they should have learned to subject all minerals, endeavor to make the children reason out the origin.

A bottle of acid and a glass dropping rod should be always ready for use.

APPENDIX

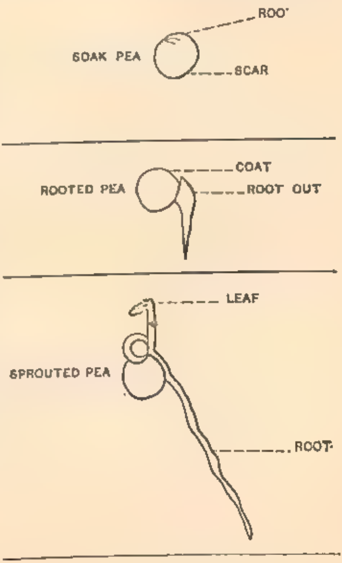
The following papers, in all cases the first and uncorrected efforts of the pupils, may be suggestive to some teachers.

For the benefit of the reader the spelling has been altered, when necessary, to the conventional form.

Second Year

These drawings were made from material grown by the teacher, after the child had grown and studied her own pea. She arranged the peas and labelled the parts without assistance.

Ida Escher,
Second Year A.



Viola Toboldt. Second Year A.

Mica

Mica grows under the ground, and it is transparent when there is only one layer. Mica grows in layers,

and is very slippery and shiny. Little pieces of mica are very silvery. Mica, I know, is soft, for I can scratch it with my finger-nail. We all can see through mica when it is thin enough.

Third Year

After numerous excursions to study the trees in the neighborhood, the children drew a plan of the plot of ground opposite the school, representing the trees by small circles. These plans they took out with them, and entirely independently of each other and of me, marked the initial of the tree below the circle which represented it.

Subsequently they were given the various leaves, of which they made drawings, as a key to the plan. No child in any class made a single mistake in identifying the leaves.

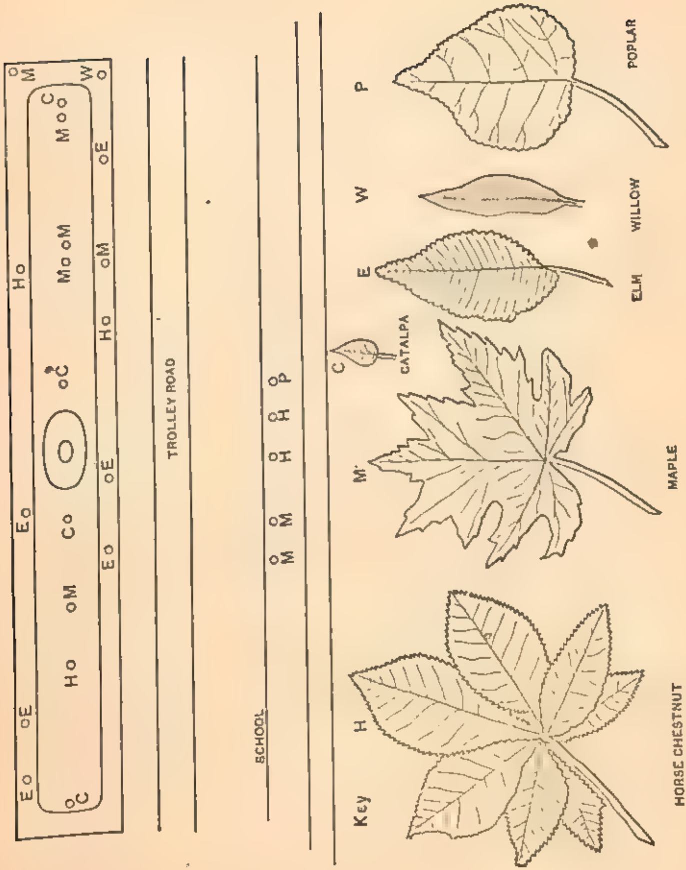
Margaret Graham, *Third Year.*

Language — Catalpa

The catalpa grows sometimes a very large tree. It has smooth bark, and it is pretty thick around the bottom. As it goes up it gets thinner. The branches of the catalpa are very large and spread out, but there are not very many. The shape of the leaf is heart shape. The veins are alternate. The edge of the catalpa is very smooth. The leaf is very large.

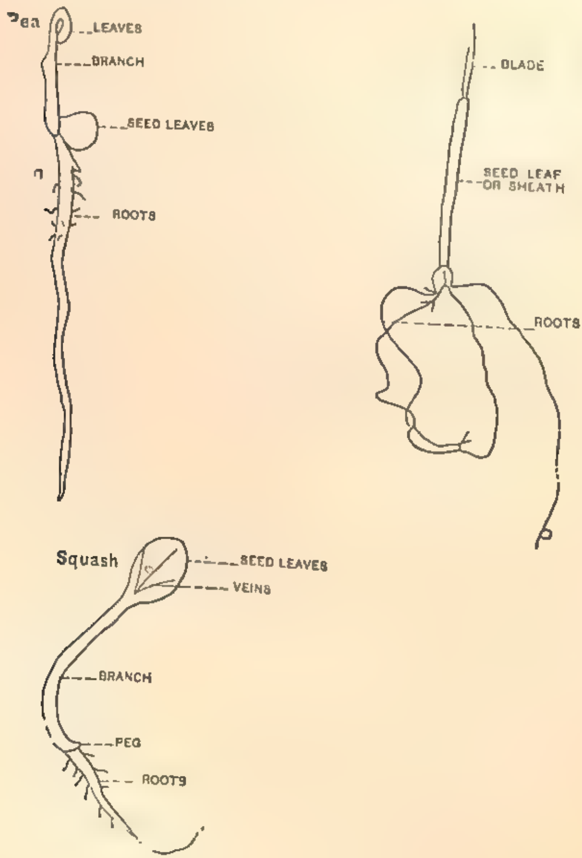
Fourth Year

The drawings below were made from material grown by the teacher, after the children had grown and studied all stages of the wheat, pea, and squash.



Francis Bowers. Third Year.

The drawings followed immediately after a lesson comparing the three seedlings, in which special emphasis was laid on the differences between the seed leaves.



Paul Lunkenheimer. Fourth Year B.

SAMUEL FERNBERGER, *Fourth Year.*

Our Seeds

The wheat, the squash, the pea, the bean, and the corn are the seeds we planted. We did not plant our seeds in earth as most people do, but took a tumbler, tied netting over it loosely, put the seeds on the netting, and poured water into the glass until it touched the seeds. The reason we planted them this way was because we could see the roots.

We placed some in the dark, some without water, one or two without warmth, while the majority were placed in the light. The ones that were put in the dark grew faster than the others, but were a lightish color, and were not green. The ones in cold froze, the ones without water dried up, the ones in the light grew green.

The peas are round, yellow, and hard. At first we saw one root breaking through the skin. This root is white. In the second stage the root has grown larger and a branch is coming up. The branch is crooked at the top, and on the top are the little green leaves. The reason that it is crooked at the top is because it is under the earth, and the tender leaves would break in their attempt in getting above the ground.

Next the pea is full grown, the root is longer and beginning to branch, the crook is straightening, branches are coming out on the main branch, and the leaves are unfolding. It is by this time above the earth.

The reason the root is branching is because it wants more food, and is so tall and wants a stronger foundation. Branching veins are on the leaves.

The wheat is another seed not near as large as the pea. In the first stage the roots are coming out, not one, but

three or four. In the next stage the roots have grown larger, and one more is added to the rest. The branch is showing itself. It is not crooked on top, but grows straight up. Next we find the blade coming out of a covering called the sheath. This sheath is there to protect the wheat until above the ground. The sheath is white, and the blade is green. Parallel veining is in the wheat.

Lastly, everything is grown larger. The roots increase in number and are longer.

ADDITIONAL LITERATURE

Poems for the Months.

There is a stanza or more descriptive of each month in the following books and poems:

Little Folks' Lyrics, F. D. Sherman.
Poems, Helen Hunt Jackson.
Poets' Calendar, Longfellow.
The Months, Mary Howitt.
September, Dr. S. Weir Mitchell, Poems.
October, Dr. S. Weir Mitchell, Poems.
October, Lucy Larcom.
October, Margaret E. Sangster, in Easter Bells.
November, Lucy Larcom.
November, Susan Coolidge.
November, R. H. Stoddard.
December, Mary E. Blake, Poems.
April! April Are You Here, Dora Goodale.
April Snow Storm, George H. Boker.
April, Susan Coolidge.
April the Handmaiden, Nora Perry, in New Songs and Ballads.
May, T. B. Aldrich.
May, Susan Coolidge.

Song of May, Nora Perry, in New Songs and Ballads.
In Maytime, Mary E. Blake, in Verses Along the Way.
June, Mary E. Blake.
June Comes in To-morrow, Elaine Goodale.

POEMS FOR THE SEASONS.

Autumn Song, Will Carleton.
Autumn Bouquet, Nora Perry, in After the Ball.
At Harvest Time, in Lilliput Levee.
Thanksgiving Day, Nora Perry, in New Songs and Ballads.
Thanksgiving, A Thanksgiving Feast, Miss Lucinda's Opinion, } Margaret E. Sangster, in Easter Bells.
Song for Winter, F. D. Sherman, in Little Folks' Lyrics.
The White Days of Winter, { Margaret E. Sangster, in Little Lords and Ladies.
Winter, in Lowell's Vision of Sir Launfal.
Kriss Kringle, F. D. Sherman, Little Folks' Lyrics.
Christmas Greeting, Lucy Larcom.
Old Year to the New, Nora Perry, in New Songs and Ballads.
A New Year, { Margaret E. Sangster, in Little Lords and Ladies.
Spring Song, Spring, } Elaine Goodale, in Poems of Two Children.
Spring's Coming, F. D. Sherman, in Little Folks' Lyrics.
Race of the Flowers, in Lilliput Levee.
The Flowers, Mrs. Dodge, in Verses Along the Way.
Spring, R. H. Stoddard.
Secrets of Spring, Nora Perry, New Songs and Ballads.

Add to page 15:

Flying Kite, F. D. Sherman, in Little Folks' Lyrics.
Merry Wind, The Four Winds, } Margaret E. Sangster, in Little Lords and Ladies.
The Weather Vane, Edith Thomas, in New Year's Masque.
The Wind to His Enemy, in Lilliput Levee.

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Flying Kite, F. D. Sherman, in Little Folks' Lyrics.
Merry Wind, The Four Winds, } Margaret E. Sangster, in Little Lords and Ladies.
The Weather Vane, Edith Thomas, in New Year's Masque.
The Wind to His Enemy, in Lilliput Levee.

Add to page 18:

Clouds,
The Rainbow, } F. D. Sherman, in Little Folks' Lyrics.
Fairy Story,
Weather Vane, Susan Coolidge.

Add to page 37:

Golden Rod, F. D. Sherman, in Little Folks' Lyrics.

Add to page 38:

In Fern Land, E. C. Stedman.
Fringed Gentian, Susan Coolidge.
Fringed Gentian, Edith Thomas, in Fair Shadow Land.
Water Lily, Lucy Larcom.
Mondamin (Corn), Bayard Taylor.
Secret of the Sunflower, from Lilliput Levee.

Add to page 61:

Fireflies,
The Grass World, } Mrs. Dodge, in Verses Along the Way.
Hives and Homes, Phœbe Cary.
Bees in the Meadow, { Margaret E. Sangster, in Little Lords and Ladies.
A Charge to the Bees, Susan Coolidge.
Jester Bee,
Bees, } F. D. Sherman, in Little Folks' Lyrics.
In the Meadow,
Baby Bye, Theodore Tilton.
Bee, Sidney Lanier.
Charge to the Bees, Edith Thomas, in New Year's Masque.

Add to page 69:

Rainbow, Wordsworth.
Rainbow, F. D. Sherman, in Little Folks' Lyrics.
The Rainbow, John Keble.

Add to page 99:

The Merry Wind, } Margaret E. Sangster, in Little Lords and
The Ripened Leaves, } Ladies.
Leaves at Play, F. D. Sherman, in Little Folks' Lyrics.

Add to page 101:

Child and the Bird, { Margaret E. Sangster, in Little Lords and Ladies.

Robin Redbreast, Allingham.

Add to page 109:

Little People of the Snow, Bryant.
A Story for Wee Willie Winkle (North Wind and Frost), } Wiltse's Stories for Kindergartens.
The Snowflake, Margaret E. Sangster, in Little Lords and Ladies.
Snow Flake,
Snow Song,
Snow Weaver, } F. D. Sherman, in Little Folks' Lyrics.

Add to page 116:

Christmas,
Holly and Pine, } Margaret E. Sangster, in Easter Bells.
Of All Dear Days, Nora Perry, in After the Ball.

Add to page 128:

Fish or Frogs, Wiltse's Stories for Kindergartens.
The Housekeeper (The Snail), Charles Lamb.

Add to page 158:

Leak in the Dyke, Phœbe Cary.
Dew Bells, Edith Thomas, in O Fair Shadow Land.
Wizard Frost,
The Juggler,
A Fairy Story,
Fairy Jewels,
A Dewdrop, } F. D. Sherman, in Little Folks' Lyrics.
The River, Caroline B. Southey.

Add to page 175:

March Crocuses, Phœbe Cary.
Snowdrop, Edith Thomas, in Lyrics and Sonnets.

Add to page 184:

Bernard Palissy,
Grandma Kaoline, } Wiltse's Stories for Kindergartens.

Add to page 193:

Carl and the Earthworm, Wiltse's Stories for Kindergartens.
Robin's Apology,
In the Orchard, } F. D. Sherman, in Little Folks' Lyrics.

Add to page 229:

The Birch Tree, Susan Coolidge.
The Birch Tree, Edith Thomas, in New Year's Masque.
Dovecote Mill (Sugar Making), Phœbe Cary.

Add to page 235:

Legend of the Cowslip, Wiltse's Stories for Kindergartens.
Snowdrop,
Anemone, } Susan Coolidge, in Songs and Lyrics.
Snowdrops and Crocus,
Violets, } Margaret E. Sangster, in Easter Bells.
The Violet, Herrick.

Add to page 253:

What are Dandelions? Wiltse's Stories for Kindergartens.
Blossom Snow (Apple), Mrs. Dodge, in Verses Along the Way.
Apple Blossoms,
Charge to the Bees (Apple Blossoms), { Edith Thomas, in New Year's Masque.
Apple Blossoms, Nora Perry, in After the Ball.
Daisies,
Cherries, } F. D. Sherman, in Little Folks' Lyrics.
Daisies, Mary E. Blake, Verses Along the Way.

INDEX

BOOKS ON NATURE.

BADENOCH (L. N.). — **The Romance of the Insect World.** By L. N. BADENOCH. With Illustrations by Margaret J. D. Badenoch and others. *Second Edition.* Gilt top, $1.25.

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